FRDA REPORT 017

# UTILIZATION OPPORTUNITIES FOR WESTERN RED CEDAR - A REVIEW 1/

BY
M.R.C. MASSIE

Contractor: Nawitka Resource Consultants Ltd
836-840 Cormorant
Victoria, B.C.

Departmental Authority:

G.H. Manning
Pacific Forestry Centre
Canadian Forestry Service
Victoria, B.C.

September, 1987

1/ This report has been reviewed by the Canadian Forestry Service and approved for distribution. Approval does not necessarily signify that the contents reflect the views and policies of the Canadian Forestry Service. Mention of trade names or commercial products does not constitute recommendation or endorsement for use.

ISSN 0835 0752

Table of Contents


| | |
|---|---|
| INTRODUCTORY NOTE | i |
| SUPPLY OF RED CEDAR | 1 |
| RED CEDAR PRODUCTS | 3 |
| Future Product Opportunities | 4 |
| Shakes and Shingles | 5 |
| Mill Residues and Wastes | 7 |
| Pulping | 7 |
| Veneer and Boards | 8 |
| Lumber and Related | 9 |
| Miscellaneous Products | 9 |
| TRENDS IN U.S. MANUFACTURES HAVING SOME RED CEDAR USE OR COMPONENTS | 11 |
| SHAKE AND SHINGLE PRODUCERS | 12 |
| POTENTIAL OPPORTUNITIES - SPECIALTY PRODUCTS | 14 |
| PRIORITIES FOR FEASIBILITY, R & D, AND MARKET INVESTIGATION | 16 |
| Shake and Shingle Situation Review | 16 |
| Cedar Specialty Products | 16 |
| Small Mill and Local Use Survey | 17 |
| Japan - Preliminary Technical Investigation | 17 |
| BIBLIOGRAPHY | |
| APPENDICES | |

INTRODUCTORY NOTE

Some material not directly referenced in the body of this report has been placed in the Appendices. This material is pertinent to the general topic, but did not require discussion.

Appendix 6 - A 1983 technical review of red cedar products, from D. Minore, with references.

Appendix 7 - Canadian and U.S. Associations listing that would likely have an interest in red cedar.

# UTILIZATION OPPORTUNITIES FOR WESTERN RED CEDAR - A REVIEW

## SUPPLY OF RED CEDAR

Red cedar is a major component of the western coniferous forest from northern California to southern Alaska. Table 1 shows the 1977 sawtimber inventory for the resource by region. There is about 34 billion bd.ft. in the western U.S. and about 160 billion bd.ft. in British Columbia. The annual harvest is about 958 million bd.ft in the U.S. and 1750 million bd.ft. in B.C. Most of the U.S. cut is concentrated in Washington state. Most of the Alaska cut, largely logs and bolts from the south Tongass National Forest, is shipped to Washington state for manufacture. In British Columbia, the largest cut is from the South Coast, followed by the Southern Interior. The area having the largest inventory, the Mid and North Coast, has the lowest annual harvest.

A further 1.2 billion bd.ft. of cedar logging debris and dead trees is considered to be partially available for shake and shingle cutters in Western Washington (Bolsinger 1979). On the South Coast (Vancouver Forest Region) Manning and Massie (1981) found some 30% of sound logging debris was red cedar. Over 50% of this material was of a size suitable for the manufacture of shake and shingle blocks, and was heavily concentrated at landing areas. While all of this sound waste of 70 $m^3$/ha may not be useable or available from recent past years (i.e. still accessible and not burned, etc.), an annual potential of 10 $m^3$/ha of shingle and shake material per ha harvested can be considered. In the Vancouver Forest Region about 35,000 ha of old growth timber are clear-cut annually. Thus a

potential is estimated of some 77 million bd.ft. annually for shake and shingle manufacture from waste and debris on the South Coast, not including past accumulations which could be substantial.

Table 1. Inventory volumes and annual cut of red cedar sawtimber, by region, Western North America, 1977

| Region | Inventory (billion bd.ft.Scribner) | Annual Cut (mil.bd.ft.Scribner) |
|---|---|---|
| California | .08 | n.a. |
| Montana | 1.42 | 13 |
| Idaho | 7.85 | 200 |
| S.E. Alaska* | 6.32 | 20 |
| W. Oregon | 4.99 | |
| E. Oregon | .03 | |
| Oregon | 5.03 | 165 |
| W. Washington | 12.20 | |
| E. Washington | .85 | |
| Washington | 13.05 | 560 |
| Interior B.C. | 25.00 | 500 |
| North Coast B.C. | 89.00 | 250 |
| South Coast B.C. | 46.00 | 1000 |
| British Columbia** | 160.00 | 1750 |
| TOTAL | 193.75 | 2708 |

* Tongass National Forest only

** B.C. Inventory figures adjusted for cut from 1970 to 1977;
1 m3 = 221 bd.ft. Scribner log rule

SOURCES: MOF, Forest and Range Resouce Analysis Technical Reports, 1980
Forest Inventory Statistics of B.C., 1972
MOF Annual Reports
Bolsinger, 1979
Glass et al, 1980

## RED CEDAR PRODUCTS

The log volumes harvested in Canada and the U.S. are allocated to the product categories shown in Table 2. The intent is to show type(s) of product produced. The U.S. shows a significant production of shakes and shingles. Bolsinger estimates 3.9 million squares in 1976, but Glass et al (1980), based on mill surveys, put the figure closer to 5 million squares. The third largest use (after lumber, and shakes and shingles) is export logs. Less than 10% of the total goes to other uses.

The Canadian situation is somewhat different. Few logs are exported and in addition to lumber and shakes and shingles, a high percentage of the cut is directed into other manufactures. The percentages shown can only be considered approximate, but in general show a more diverse situation than in the U.S.

Two points should be noted. On a proportional basis more cedar in B.C. goes into veneer and plywood; posts, poles and piling; and pulp and board. Second, in addition to major lumber manufacturers and major pole producers, there is a significant number of small to medium cedar producers that specialize in cedar manufactures such as rough lumber, decking, boards, pattern stock, shakes and shingles, siding, panelling, fence and furniture material. As shown in Appendix 1, a large number of these are concentrated in the Fraser Valley. Some of this material is consumed locally, but most is exported to the United States.

Table 2. Estimated red cedar products produced in B.C. and the U.S. from the annual cut, as a percent of red cedar log volumes harvested.

| Product | U.S. (1976) | B.C. (1977) |
|---|---|---|
| | percent | |
| Lumber | 46 | 52 |
| Shakes and Shingles | 38 | 19* |
| Log Export | 9 | 1** |
| Veneer and Plywood | 5 | |
| Posts, Poles and Piling | 2 | 28 |
| Pulp and Board | (< 1%) | |
| Log Volume Harvested | 958 (mil.bd.ft.) | 1750 (mil.bd.ft.) |

* Not including shakes and shingles manufactured from waste or logging debris.
B.C. production 1977: From logs = 3,000 M squares
From waste (est.) = 300 M squares

** Includes some shake and shingle bolts or blocks.

SOURCE: Bolsinger, 1979
MOF Annual Report, 1977
Council of Forest Industries of B.C. Annual Report, 1977

## Future Product Opportunities

Based on the physical resource, opportunities for increased utilization of old growth red cedar in the U.S. (with the possible exception of S.E. Alaska) appear limited. In the case of Alaska, the situation is focused more on requiring within-state manufacture, rather than exporting logs to Washington state (Glass et al 1980).

All in all, increased utilization of the resource in the U.S. to produce lumber and shakes and shingles does not seem likely, and some (Bolsinger 1979) believe that if shake and shingle consumption does not decrease more and more of this product will come from B.C. At the same time, B.C. is already supplying more volume of cedar manufactures described above than U.S. producers to U.S. markets. Although western red cedar is only a small component of total U.S. softwood production, it is interesting to note that U.S. softwoods have undergone real price increases in recent years, which is consistent with timber scarcity. Skog and Risbrudt (1982) report that between 1961 and 1980 stumpage increased at a rate of 5.5%, sawlogs at a rate of 4.0% and lumber at a rate of 3.1% annually.

This mix of products or specialty items is produced by both primary and secondary manufacturers (Johnson 1986; Blackman 1983) and some friction exists between the two over log supplies and volumes of specific items produced when prices in the U.S. markets fluctuate. Reportedly the largest red cedar mill (BCFP Hammond) now specializes in exterior siding and panelling and interior panelling.

## Shakes and Shingles

Since 1977 B.C. has continued to produce about 3000 M squares of shakes and shingles annually. About 60% of world needs is supplied by B.C., and the U.S. takes about 90% of that production. The industry is concentrated in the Fraser Valley, with the 50 or so mills largely small to medium size and independent of major B.C. softwood lumber producers. The two majors who produce are Whonnock and Canfor. The

industry is labour intensive and most of the raw material is purchased from the Vancouver Log Market. In the last few years some material has been taken from logging shows and harvested areas by helicopter to adjacent access roads for truck transport to the mills. Most mills rely on brokers for marketing in the U.S. The major market is California, followed by Florida and Texas (Sorenson 1983).

In addition to the mills in the Fraser Valley several small firms operate on the South Coast. Much of their wood comes from salvage operations as they do not have ready access to the log market (Westergaard 1982; Crosby 1981).

Since the imposition of the tariff, shipments to the U.S. declined and the U.S. market price rose. At the same time the log prices for cedar shake and shingle material in the Vancouver Log Market declined as log shipments to the U.S. were curtailed with the advent of the tariff. Under the condition of cheaper raw material costs and higher U.S. market prices, shipments to the U.S. are increasing. It is not clear if export levels previous to the tariff can be attained again, but with U.S. demand (and prices) apparently holding and logs increasing in scarcity in the U.S., the Canadian situation cannot be considered as bad as first imagined (Globe and Mail, Report on Business, October 14/86; see Appendix 2). Similarly, for those mills producing other cedar specialty products in the Fraser Valley, some may have been exempted from the recent softwood lumber tariff. Also, U.S. importers of cedar specialty products and shop lumber have requested that these products be exempted under the forthcoming December 30 ruling (Globe and Mail, Report on Business, October 18/86, see Appendix 3).

## Mill Residues and Wastes

Cedar shavings or "tow" from the manufacture of shakes and shingles are used in nurseries in combination with peat moss to package and store trees and plants. Some of this material has been baled by western mills and shipped to nurseries in the midwest (Burgess 1978). Bark, sawdust and shavings find occasional use, largely local, in plant mulches, soil conditioners and animal litter. Wide acceptance has not developed because of cedar toxicity and nitrogen depleating action as well as cultivating difficulties with "stringy" material. Cedar is also slow to compost. As a packing material cedar sawdust, wool or tow is detrimental to certain fruits and vegetables, particularly apples. Course sawdust and clean shavings find considerable use for animal litter or bedding. The material is believed to have some insecticidal properties, and has good moisture absorbency and odor masking properties. Chipped bark is used as a decorative and weed controlling mulch in many areas. Most agricultural or horicultural use is located in the regions where mills are located. Some chips and heavy sawdust are pulped and some material is burned for energy. Again, this is usually in the regions where the mills are located (Bollen and Glennie 1961, Scroggins and Currier 1971, Lunt and Clark 1959, McBride 1959).

## Pulping

Red cedar is not widely used for pulping because of its low density and because it increases equipment corrosion. Also, older wood, highly desirable for other products, has a high degree of decay

which, if directed into pulp chips, requires more expensive handling and screening. Small amounts are used in sulphite mills. Red cedar can be pulped satisfactorily by the kraft process and some mills include red cedar in their furnish. In some situations, the material need not be barked or be bark free. Research appears to indicate that unbarked red cedar has considerable potential for kraft pulping, but that the mill(s), because of handling, yields and corrosion considerations, would have to be designed for that purpose (Hunt July 1978, August 1978; Thomas and Davis, 1974; Wither and Captein 1969; Keays and Hatton 1974).

Veneer and Boards

While red cedar is used for veneer and plywood, very little is rotary cut for sanded cedar plywood panels. Hailey et al (1973) indicate that the "flaking" problem can be overcome provided tight control is maintained over cutting equipment and settings, and the bolts are properly conditioned. They believe that some potential exists for cutting mill-run cedar logs.

Considerble research has been conducted on boards made from red cedar waste and/or bark (Chow 1977; Stewart & Butler 1968), but very little is available on increased or new uses. Hofstrand et al (1984) indicate that there is some potential for red cedar-portland cement structural particleboard, but that other species have a higher potential. Considerable literature exists on world wide research but little on use or markets. Heebink and Lewis (1967) indicate that thick western red cedar particleboard makes good roof decking and that particleboard roof decking is used in the U.S.

## Lumber and Related

Considerable literature exists on cutting, slicing, jointing and laminating red cedar lumber (Troughton and Chow 1979, Lutz et al 1962, Filler et al 1964, St. Laurent 1979). However little of the literture points to or can be related to improved markets for low quality red cedar with the possible exception of finger-jointing. The Troughton and Chow study indicates fingerjointing of red cedar into longer length boards is feasible under a wide range of manufacturing conditions. Two known manufacturers in B.C. that are improving quality by finger-jointing are Starline Cedar Mills Ltd of Williams Lake and Mardan Enterprises Ltd of Armstrong. Both Starline and Jacobson Brothers Forest Products in Williams Lake utilize decadent cedar (Grant, 1979). B.C. supplies most of the Canadian lumber exports to Japan. In 1985 some 2.35 million $m^3$ of six species groups were exported to Japan. Only 71,000 $m^3$ were red cedar (Kaufmann, October 1986).

## Miscellaneous Products

Use of extractives from red cedar waste appears to have little commercial application to date, although some potential is believed to exist for the volatile oils. Cedar leaf oil, used in perfumes and other products such as soaps and polishes, is extracted from the leaves and twigs and not bark or waste wood fibre (Wethern 1959, Gardner & Barton 1958, Barton 1973). Red cedar has been tested unsuccessfully for the induction of resin and turpentine. The only western species thought to have potential was lodgepole pine (Sandberg et al 1977). Similarly, red cedar bark was unsuccessfully tested as a "scavenger" for heavy metal ions in treating toxic waste water. Several barks

performed well, especially coastal redwood, but not cedar (Randall et al 1976).

Most pallets are made from hardwood, but some red cedar plywood and particleboard is used in pallets. Pallets made from softwoods suffer particularly from leading-edge impact damage. Nethercote et al (1974) tested overlaid panel pallets with banded leading edges and found performance vastly improved. Red cedar particleboard was very successful as core material.

In the Western U.S. and Canada red cedar is widely used for posts, fencing and small poles. Fraser Valley manufacturers list production of a variety of these products including mine timbers and hop poles. Specifics as to mine use could not be determined from the literature (Stone et al 1985, Miller and Graham 1970).

In the U.S. an increasing use of wood is for sound barriers and fencing around highways and streets. Red cedar is eminently suited to this use (Spelter, 1985).

Burning wood waste (including red cedar) for energy was not considered to be within the scope of the review, although further investigation might be warrented if a milling centre continues to develop in the Fraser Valley and waste disposal becomes a more critical problem. Several communities in California generate electricity from bark and wood wastes. A recently completed facility uses mainly redwood bark and meets high environmental standards (Forest Industries, October, 1986).

## TRENDS IN U.S. MANUFACTURES HAVING SOME RED CEDAR USE OR COMPONENTS

The total amount of lumber used in farm building construction decreased from 2.7 billion bd. ft. to 2.3 billion bd. ft. from 1960 to 1970. Pole use increased slightly from 68 million linear ft. to 74 million linear ft. and plywood increased from 953 million sq. ft. to 1,138 million sq. ft. over the same period (Reid and Baumgartner 1977). The use of lumber and "boards" (plywood, veneer and hardboard) in packaging and shipping has slowly increased since 1970. Most of this material is used in pallets, containers and dunnage, and the increase is largely due to increased pallet use. Estimates for the 1980's indicate annual consumption of about 9 billion bd. ft. (mainly hardwood) of lumber, slightly over 1 billion sq. ft. of plywood and veneer (3/8" basis) and 100 million sq. ft. of hardboard (1/8" basis). The use of slip-sheets (thin sheets of fibre, board or plastic) are expected to increase and hence light weight or low quality pallet use, particularly in the food industry, should decline (McKeever and Dickerhoof 1980). Lumber use in mobile home construction varies considerably but appears to be about 2,500 bd. ft. per unit. Annual sales in the U.S. (1977-1980) were estimated at about 400,000 units, indicating an annual lumber use of about 1 billion bd. ft. (Dickerhoof 1977).

Softwood lumber consumption by the furniture and fixtures industry (not including kitchen cabinets) was estimated at 670 million bd. ft. in 1977. Softwood plywood used was 630 million sq. ft. (3/8" basis), particleboard 1,160 million sq. ft. (3/4" basis) and hardboard 880 million sq. ft. (1/8" basis) (Spelter, et al. 1978).

Total softwood lumber used in manufacturing in the U.S. based on the 1977 Census of Manufacturers was:

| | billion bd. ft. |
|---|---|
| Millwork plants | 2.04 |
| Structural Members, n.e.c. | 1.11 |
| Wood Products, n.e.c. | 1.11 |
| Wood Pallets & Skids | 0.72 |
| Wood Household Furniture | 0.69 |
| All Other Industries | 4.50 |
| Total | 10.17 |

Other softwood items used in manufacturing were:

| | | million |
|---|---|---|
| Softwood bolts | 387 | bd. ft. |
| Softwood plywood | 1,798 | sq. ft. (3/8" basis) |
| Softwood veneer | 324 | sq. ft. (3/8" basis) |
| Hardboard | 2,093 | sq. ft. (1/8" basis) |
| Insulation board | 734 | sq. ft. (1/2" basis) |
| Particleboard | 2,932 | sq. ft. (3/4" basis) |
| Medium density fibreboard | 508 | sq. ft. (3/4" basis) |

Source: McKeever & Martens 1983

## SHAKE AND SHINGLE PRODUCERS

Several factors should be clarified with respect to the shake and shingle industry. Apparently, and in spite of the tariff, the industry has not reduced production to levels that the tariff might have suggested. Some production by major companies was curtailed, but currently most of these are producing again. Current exports to the U.S. are not clear, and exact levels need to be clarified. A key question that would be vital to any Canadian policy or strategy would be to ascertain not only if demand is still strong enough in the U.S.

to absorb both current U.S. production and Canadian imports at higher prices (see Appendix 4), but also if the market share is not being eroded by other roofing materials. If this, even in part were the case, there would be definite opportunities for Canadian producers as the tariff is scheduled to decline (See Appendix 5), and the U.S. producers are facing declining physical supplies of the necessary raw material.

In addition to clarifying exports to the U.S., some attention should be directed to the potential for increased sales to Canadian markets and sales overseas including Japan. These markets relative to the U.S. appear to be quite small.

Several other questions need clarification with respect to the industry. Some part of the industry is dependent on the Interior Wet Belt and some on scattered coastal areas, but a major part of the industry is concentrated in the Fraser Valley and is dependent on log supplies from the Vancouver Log Market. Is this industry dependent on the low quality logs in the market, and will they have access to a reasonably secure future supply of raw material? Similarly, to what extent is old growth cedar logging waste or debris being utilized on the coast? The latter may have considerable potential as a future source of raw material. If localized production in coast areas is low, it should be determined if impediments that can be overcome are the cause. One problem is believed to be how to sell and transport the shakes to wholesalers in the lower Fraser Valley.

If the industry in the Fraser Valley expands, waste utilization could become important as the cost of disposal is increasing. Cedar

waste from shake and shingle mills can be used for agricultural mulches and animal bedding, and under certain circumstances burned for energy generation. It may also have some limited potential for oil spill clean-up and highway or road fill under certain conditions.

## POTENTIAL OPPORTUNITIES - SPECIALTY PRODUCTS

A large number of the mills producing shingles and shakes as well as other small cedar mills produce a variety of products for local and B.C. consumption. These include rough lumber, both dimension and boards, in short lengths. A lot of this is used for general utility purposes in both residential and farm maintenance such as fencing, sheds, patios, etc. Some of this rough material, largely boards, has found a place as "rustic" panelling and ceiling boards in residential housing and scattered small business offices. Other products include rough timbers and posts (some for mines) as well as lath, garden stakes and trellis material. Any further development of this market may not be feasible as it is probably in line with local demand.

A number of mills produce siding and panelling as well as cabinet and furniture stock. Some are finger jointing. Much of this material is exported to the U.S. Some potential for expanding this market may exist, but it could be limited as the mills, while using "short" lengths, cut largely quality material. One area which might be explored is pre-cut and packaged, tongue and groved, cabinet and panelling stock. This item is appearing at U.S. retail "building needs" centres. Some of this comes from Canada and some of it is red

cedar. It is not clear to what extent this is packaged in Canada, or finished and packaged in the U.S.

A similar product to the above at the same type of outlet is "bolt together" shelves, tables, racks and benches for general utility use both indoor and out-of-doors. The smaller items are completely packaged with assembly hardware and instructions, but larger items are sold in bundles. These include racks and benches for assembly in basement areas, racks and shelves for in-house child play areas, and barbeque accessories including racks, tables and benches of various design. Red cedar, because of its light weight and durability, should be suited to this market.

The whole area of outdoor furniture, greenhouse accessories, and patio components should be considered from a non-local point of view. Where these items are not sold in "kit" form, they are assembled in or near the market area. Some unknown potential exists to supply red cedar stock or blanks to these businesses in other areas of Canada and the U.S. This type of market is likely to exhibit some of the characteristics of the furniture and fixtures market and may not be easily penetrated or further developed. Some problem areas could include "tight" component specifications (some operate without a re-saw capability) and quality criteria. In addition, security of supply and scheduled delivery is frequently a must. Shipments must be easily handled, secure against damage and weatherproof. Furniture manufacturers and assemblers are frequently limited on storage space and prefer smaller shipments of components more frequently scheduled than some suppliers/mills would like.

Although it might not warrent investigation at this time, the whole question of the use of cedar (or lack of use), including lumber, by the Japanese should be considered. In the past much of this trend has been blamed on fire hazard and regulations. It is not clear if this situation has changed significantly, or whether some cedar products might be saleable in selected Japanese markets.

## PRIORITIES FOR FEASIBILITY, R & D, AND MARKET INVESTIGATION

This listing considers the possibility that a significant tariff induced curtailment of shake and shingle exports to the U.S. may not occur.

I. Shake and Shingle Situation Review

(a) Export situation (particularly to U.S.)

(b) Producer situation

i) industry general welfare; recent production changes
ii) sources and volumes of raw material

(c) U.S. situation

i) production and raw material supplies
ii) market and competing materials situation

II. Cedar Specialty Products (considers mainly short logs and bolts = 3.8 m or less)

(a) Lower Quality Products
(items made from short lengths and/or clear wood to tight knot wood, some finishing)

(b) Medium to High Quality Products
(items made from 'longer' lengths, but still less than 3.8 m, mostly clear wood and usually finished)

Survey producers to more clearly identify opportunities. Follow with market research, and then analyses to determine if increased production is feasible.

III. Small Mill and Local Use Survey

Survey small producers producing rough lumber in short lengths, rough timbers, fencing, stakes or lath, etc. Consider their sales and/or contact purchasers to estimate if local and/or B.C. needs present any further opportunity.

IV. Japan - Preliminary Technical Investigation

Find out from major sources (i.e. government, wood products manufacturers, trading companies, etc.) current fire hazard and regulations pertaining to wood in housing, public buildings or offices, etc. What is the status of wood treated with fire retardants, etc. What regulations govern the use of, for instance, wood panelling in detached homes or in steel and concrete office buildings, etc. Analyse information to determine if further investigation of the use or promotion of red cedar would be feasible.

# BIBLIOGRAPHY

# BIBLIOGRAPHY


B.C. Ministry of Forests. 1977; 1984-85. Annual Reports. Victoria

Barton, G.M. 1973. Wood Chemistry of Western Conifers. WFPL Information Report VP-X-106.

Blackman, T. 1983. World's largest cedar mill now in high-tech quarters. Forest Industries 110(10):26-28.

Bollen, W.B. and D.W. Glennie. 1961. Sawdust, bark and other wood wastes for soil conditioning and mulching. For. Prod. J. 11(1):38-46

Bolsinger, Charles L. 1979. Western Red Cedar - a forest resource in transition. USDA FS, PNW Range and Experiment Stn., Portland. Resource Bulletin PNW-85.

Burgess, 1978. Selling waste to nurseries. Wood & Wood Prods. 83(11):38-39

Chow. S. 1977. Properties of bark boards made with ozone treatment. Wood Science 9(3):124-129.

Council of Forest Industries of B.C. 1977. Annual Report.

Crosby, R. 1981. Nothing comes easily for small shakers. Truck Logger 4(3):32-33.

Dickerhoof, H.E. 1977. Lumber use trends in mobile home construction. USDA Forest Products Lab. Madison. Forest Service Research Note FPL-0237.

Filler, M.C., A.D. Hofstrand, J.P. Howe. 1964. Studies in laminated beam design for four western softwoods. Forest Products Journal 14(10):451-455.

Forest Industries. 1986. Another wood-fueled plant fires up its generators. October. p. 23.

Gardner, J.A.F. and G.M. Barton, 1958. The extraneous components of western red cedar. Forest Products Journal 8(6)):189-192.

Glass, R.J., G. Lindell, G. Harpole, and T. Meyer. 1980. An analysis of the market potential to manufacture western red cedar products in southeast Alaska. USDAFS, Alaska Region and Range Experiment Station. Alaska Region Report #88.

Grant, Peter. 1979. The ugly duckling of the Cariboo forests. ForesTalk, BC Ministry of Forests, Victoria. Winter 1979.

Hailey, J.R.T, W.V. Hancock, D.C. Walser. 1973. Peeling western red cedar for sanded panels. CFS, WFPL, Information Report VP-X-109, 14 p.

Heebink, Bruce G. and Wayne C. Lewis. 1967. Thick Particleboards with pulp chip cores - possibilities as roof decking. USDAFS Research Note FPL #174. Madison, Wisconsin.

Hofstrand, A.D., A.A. Moslemi, J.F. Garcia, 1984. Curing characteristics of wood particles from nine northern Rocky Mountain species mixed with portland cement. Forest Products Journal 34(2):57-61.

Hunt, K. 1978. Kraft pulping of decayed wood: western red cedar and alpine fir. Pulp & Paper Canada 79(7):30-35.

Hunt, K. 1978. How rot-decayed wood affects chipping and kraft pulping. Pulp & Paper Canada 79(8):65-68

Johnson, L. Ward. 1986. B.C. remanufacturer plans upgrade to further expand world markets. Logging and Sawmilling Journal, July.

Kaufmann, Steven. 1986. A yen for the Asian Market. B.C. Lumberman/ Canadian Forest Industries. October.

Keays, J.L. and J.V. Hatton, 1974. The effect of bark on wood pulp yield and quality and on the economics of pulp production. CFS, WFPL Information Report VP-X-126, 20 pp.

Lunt, O.R. and B. Clark. 1959. Horticulture applications for bark and wood fragments. For. Prod. J. 9(4):39A-42A.

Lutz, J.F., H.H. Haskell, R. McAlister. 1962. Slicewood - A promising new wood product. For. Prod. J. 12(5):218-227.

Manning, G.H. and M.R.C. Massie. 1986. Characteristics of logging residues in the Vancouver Forest Region, 1981. Information Report BC-X-279. Pacific Forestry Centre, Victoria.

McBride, C.F. 1959. Utilizing residues from western red cedar mills. Forest Products Journal 9(9):313-316.

McKeever, D.B. and D.G. Martens. 1983. Wood used in U.S. Manufacturing industries, 1977. USDA Forest Products Lab. Madison. Forest Service Resource Bulletin FPL-12.

McKeever, D.B. and H.E. Dickerhoof. 1980. Lumber and panel products consumption for packaging and shipping in the U.S. - a perspective for the '80's. USDA Forest Products Lab. Madison. Forest Service Resource Bulletin FPL-10.

Miller, D.J. and R.D. Graham, 1970. Durability of Douglas-fir hop poles treated with preservatives by diffusion. Forest Products Journal 20(6)):43-44.

Minore, Don. 1983. Western red cedar - a literature review. USDA FS. Pacific Northwest Forest and Range Experiment Station. General Technical Report PNW-150.

Nethercote, C.H., J.R. Reeves, A. Manseau. 1974. Overlaid composite construction augments wood pallet strength and durability. CFS, Eastern Forest Products Lab, Ottawa, Report OP-X-102E, 11p

Randall, J.M., E. Hautala, A.C. Waiss, J.L. Tschernitz. 1976. Modified barks as scavengers for heavy metal ions. Forest Products Journal 26(8):46-50.

Reid, W.H. and D.C. Baumgartner. 1977. Wood products used in constructing farm buildings in the U.S., 1958-75. USDA Forest Products Lab. Madison, Wisconsin. Forest Service Bulletin FPL-2.

St. Laurant, A. 1979. Full size lumber slicing. IN Proceedings of the Sawmilling Clinic, Eastern Forest Products Laboratory, Ottawa.

Sandberg, D.R., F.W. Herrick, A.A. Selders. 1977. Paraquat treatment of northwest conifers for lightwood induction. Wood Science 19(1):28-30.

Scroggins, T.L. and R.A. Currier. 1971. Agricultural uses for western red cedar residues, from shake and shingle. Forest Products Journal 21(11):17-24.

Skog, K. and C. Risbrudt. 1982. Trends in economic scarcity of U.S. timber commodities. USDA Forest Products Lab. Madison, Wisconsin. Forest Service Resource Bulletin FPL-11.

Sorenson, J. 1983. Brokers ease marketing headaches for shake and shingle producers. Canadian Forest Industries 101(10):8-10.

Spelter, Henry. 1985. A profile of the nonresidential, nonbuilding construction market for lumber and plywood. USDA Forest Products Lab. Madison, Wisconsin. Resource Bulletin FPL 16.

Spelter, H, R.N. Stone, and D.B. McKeever. 1978. Wood usage trends in the furniture and fixtures industry. USDA Forest Products Lab. Madison, Wisconsin. Forest Service Note FPL-0239.

Stewart, D.L. and D.L. Butler. 1968. Hardboard from cedar bark. Forest Products Journal 18(12):19-23.

Stone, R.N., Christopher Risbrudt, James Howard. 1985. Wood products use by coal mines. Forest Products Journal 35(6):45-52.

Thomas, P.R. and R.E. Davis, 1974. Whole log chipping and pulping of western red cedar at Columbia Cellulose. Pulp and Paper Canada 75(3):60-63.

Troughton, G.E., S. Chow. 1979. Fingerjointing unseasoned, rough western red cedar lumber using the WFPL method. Forintek: Tech Rept #11.

Westergaard, B. 1982. Shake and shingle mill is located near source. Logging and Sawmilling J. 13(1)21-22.

Wethern, J.D. 1959. Pulp and chemical potential for western red cedar utilization. For. Prod. J. 9(9):308-313

Wither, R.P. and H.A. Captein. 1960. Laboratory evaluations of nitric acid pulping of bagasse and softwoods. Forest Products Journal 10(F3):174-177.

# APPENDICES

APPENDIX 1 - SELECTED MAJOR B.C. RED CEDAR MANUFACTURERS
(other than major large lumber producers*)

---

A.J. Forest Products
P.O. Box 10, Garibaldi Highlands, BC VON 1TO
898-3616
Production**: 6 M Fbm
Manufactures: Timbers, fencing, mining timber, posts

ABEDA Wood Products
P.O. Box 549, Winfield, BC VOH 1TO
766-4088
Production: 1200 pkgs
Manufactures: wallcoverings, exterior siding

Anglo American Lumber Ltd.
P.O. Box 182, Matsqui, BC VOX 1SO
P.O. Box 351, Sumas, WA
(604) 859-0366
Specialties: dimension, patterns, timbers, shakes

Aquila Cedar Products Ltd.
Box 908, Parksville, BC V0R 2S0
284-5922
Production: 35 M fbm
Manufactures: fencing, pattern stock, bevel siding, decking

Caamano Forest Industries
23552 River Road, Maple Ridge, BC V2X 7E6
467-5505
Production: 25 M
Manufactures: pulp chips, timbers, fencing, posts

---

* For major B.C. producers of well known red cedar products (i.e. lumber, shingles and shakes, preservers and plywood and veneer) see a current issue of: Madison's Canadian Lumber Directory, P.O. Box 2486, Vancouver V6B 3W7

For major producers of red cedar products in the USA, see a current issue of: Directory of the Forest Products Industry (D.F.P.I.) Miller Freeman Publications, Inc., 500 Howard St., San Francisco, CA 94105

** Per shift, unless otherwise noted

CEE-EN Lumber Ltd.
P.O. Box 879, Enderby, BC V0E 1V0
838-6866
Production: 50 M fbm
Manufactures: timbers, lath, fencing, pattern, pickets, posts, siding, decking

City Lumber Sales & Services
P.O. Box 1101, Surrey, BC V3S 4P5
576-8515
Production: 100 M fbm
Manufactures: boards, siding, decking, pattern, fencing, lath

Custom Pre-Cut Stud Mills
Box 669, Enderby, BC V0E 1V0
838-6821
Production: 80 M
Manufactures: boards, panelling, deluxe fencing

Dashwood Lumber Co
Box 3232, Langley, BC V3A 4R6
534-7805
Production: 50 M
Manufactures:
pattern, siding, boards, panelling

DeBeck Sawmills
Box 10, Garibaldi Highlands, BC VON 1T0
687-7012
Production: 8 M fbm
Manufactures: timbers, mine timbers, fencing

Delta Cedar Products
Box 234, Surrey, BC V3T 4W8
588-3044
Production: 50 M
Manufactures: clears & shop, siding, boards, dimension, panels and moulding

Downie Street Sawmills
Box 70, Canoe, BC V0E 1K0
832-2201
Production: 120 M
Manufactures: rough industrial clears, resawn stock, fencing

Drew Sawmills
General Delivery, Malakwa, BC V0E 2J0
836-2891
Production: 70 MM feet annually
Manufactures: boards, siding, pattern

Goldwood Industries
12691 Mitchell Road, Richmond, BC V6V 1M7
327-9251
Production: 100 M fbm
Manufactures: chips, timbers, fencing, posts

Grove Cedar Limited
23875 Fraser Highway, Langley, BC V3A 4R1
530-1720
Manufactures: fencing, lath and shakes

Haney Cedar Products
P.O. Box 276, Maple Ridge, BC V2X 7G2
Production: 30 M
Manufactures: pattern, siding, decking

Indian Hardwoods
P.O. Box 129, Rosedale, BC V0X 1X0
Production: 12 M
Manufactures: rough timbers, fencing, mine timbers

Island Lumber Specialties
1999 Savage Road, Richmond, BC V6V 1R1
273-4641
Manufactures: siding and panelling

K & M Sawmills
P.O. Box 653, Fort Langley, BC V0X 1J0
888-1054
Production: 15 M fbm
Manufactures: timbers, fencing, mine timbers, posts

Lakeside Timber
P.O. Box 55, Tapen, BC V0E 2X0
835-8536
Production: 15-20 M fbm
Manufactures: timbers, mine timbers, sawdust

Lamford Cedar
P.O. Box 638, New Westminster, BC V3L 4Z3
522-8681
Production: 75 M fbm
Manufactures: siding, panelling

Lindel Cedar Homes
P.O. Box 2080, New Westminster, BC V3L 5A3
580-1191
Production: 55 M
Manufactures: timbers, prefab home componets, fencing, posts, siding, decking, boards

McDonald Cedar
P.O. Box 69, Fort Langley, BC V0X 1J0
888-1616
Production: 110 M
Manufactures: siding and boards

Meadow Creek Cedar
Box 970, Kelso, BC V0G 1M0
366-4434
Production: 25 M fbm
Manufactures: timbers, pattern, mine timbers, posts, siding, decking, shingles and shakes, home components, dimension

Mica Dam Sawmills
P.O. Box 1740, Revelstoke, BC V0E 2S0
837-6262
Production: 40 M
Manufactures: timber, boards and dimension

Mill & Timber Products
12770 - 116 Avenue, Surrey, BC V3V 7H9
580-2714
Production: 110 M
Manufactures: rustic siding, rough green, panelling

Mount Paul Lumber
651 W. Athabaska St., Kamloops, BC V2H 1C5
372-5411
Production: 20 M
Manufactures: rough timbers, fencing, pallets

Nova Lumber Co.
200 Bridge Street, North Vancouver, BC V7H 1W7
929-3471
Production: 125 M
Manufactures: clears, common, fencing, timbers, siding, V-joint boards

P & E Enterprises
Box 83, Pentiction, BC V2A 6J9
493-1050
Production: 6-8 M
Manufactures: tongue and grooved and V-joint cedar

Regatta Lumber and Specialty Products
2530 Ross Road, Kelowna, BC V1Z 1M1
769-6911
Production: 10 M fbm
Manufactures: fencing, pattern, siding, decking, furniture stock, V-joint

Sawarne Lumber Company
12640 Mitchell, Richmond, BC V6V 1M8
324-4666
Production: 200 M
Manufactures: rough timbers, pattern, siding boards, posts and fencing

Starline Cedar Mills
RR #3, Williams Lake, BC V2G 1M3
392-3317
Production: 125 M fbm
Manufactures: fencing, pattern, finger joint boards, boards, siding

Talisman Cedar
Box 36, Blue River, BC V0E 1J0
673-8434
Production: 15 M fbm
Manufactures: dimension

Twin Stag Timber
Tuan Road, Box 308, Parksville, BC V0R 2S0
248-4344
Production: 75 M fbm
Manufactures: rough timbers, fencing, pulp chips

SELECTED MAJOR RED CEDAR RE-MANUFACTURES

---

Allmac Lumber
P.O. Box 3460, Langley, BC V3A 4R8
576-8576
Production: 170 M
Manufactures: fencing, boards, dimension and siding

Allwood Industries
20101 Logan Avenue, Langley, BC V3A 4L5
534-7881
Production: 60 M
Manufactures: special pattern, siding, panelling, posts, fencing

Arbor Wood Products
5820 Byrne Road, Burnaby, BC V5J 3J5
434-7755
Manufactures: panelling, pattern, moulding

Builders World
16659 Fraser Highway, Surrey, BC V3S 2X6
576-2955
Manufactures: fencing and siding

Ivishwood Industries
P.O. Box 10, Yarrow, BC V0X 2A0
823-4926
Manufactures: (balcony and mantlepiece speciality items) spindles, pickets, shutters

D.J. Kenny Lumber
1750 McLean, Port Coquitlam, BC V3C 1M9
941-4422
Manufactures: poles, cant strip, lath and lattice

Landucci Lumber
320 Ewen Avenue, New Westminster, BC V3M 5B1
525-8304
Production: 45 M
Manufactures: cut stock, glued stock, posts, boards and dimension

Lyle Forest Products
46210 4th Ave., Chilliwack, BC V2P 1N4
Manufactures: clear panelling and siding

R.L. Industries
44758 Yale Road W., Chilliwack, BC V2P 6J4
792-7400
Manufactures: moulding, panelling, dimension, fencing, lath

Riverside Forest Products
P.O. Box 399, Enderby, BC V0E 1V0
838-6415
Production: 50 M
Manufacturers: siding, panelling, decking

Woodco Forest Products
R R #1, McKinely Rd., Kelowna, BC V1Y 7P9
763-7861
Manufactures: moulding, fencing, decking, siding, V-joint, cedar
windows and doors

# SELECTED RED CEDAR WHOLESALERS/BROKERS, B.C.

Antrim Yards Ltd.
6584 - 144th St., Surrey, BC V3W 5R1
594-0408
Clears, commons, interior or exterior panelling and siding

B & G Forest Products
Box 908, Vernon, BC V1T 6M8
542-1301
Picnic table stock, fence rails

Bloom Building Products
781 Notre Dame Dr., Kamloops, BC V2C 5N8
372-3165
Moulding, clears, decking, siding, shakes & shingles

Boser Cedar Products
RR #1, Langdale, Gibsons, BC VON 1V0
886-9697
Shakes

Cedar Land Lumber
200 - 1130 Austin Avenue, Coquitlam, BC V3K 3P5
931-9111
Lumber, siding, panelling, fencing

Cedarome Wood Specialties
P.O. Box 1042, Coquitlam, BC V3J 6Z4
936-3441
Panelling, channel and boards

Cedaroof Canada Ltd.
P.O. Box 94091, Richmond, BC V6Y 2A2
278-3396
Shakes & Shingles, siding, fencing, panelling and misc. products

Central Cedar Ltd.
19278 - 56th, RR #3, Surrey, BC V3S 4N9
533-3431
Lumber

Davron Forest Products
204, 15290 - 103A Ave, Surrey, BC V3R 7A2
585-2121
Lumber

English Bay Cedar Products
#905 - 865 Hornby St., Vancouver, BC V6Z 2G3
669-0790
Lumber

Everwood Trading
10897 Timberland Rd., Surrey, BC V3V 3T6
580-2223
Fence posts, fencing, poles, lumber

Green Briar Sales Ltd.
P.O. Box 1256, Vernon, BC V1T 6N6
545-2374
Clears, V-joint, decking, lumber

Hakai Forest Products
3215 Connaught Cres., North Vancouver, BC V7R 2V7
984-9766
Siding, fencing, decking

Kodiak Cedar Products
20280 Industrial Avenue, Langley, BC V3A 4E6
530-6415
Lumber, specialty shop and clear

Mardan Enterprises
RR #1, Phillips, C-6, Armstrong, B.C. V0E 1B0
546-6846
Finger jointing, fingerjoint panels

Pat Power Forest Products
#200, 19623 - 56th Avenue, Langley, BC V3A 3X7
530-9326
Channel and bevel siding, T & G, V-joint boards, fencing, dimension and lowgrade

Quadra Wood Products
P.O. Box 3247, Langley, BC V3A 4R6
Siding, boards, fencing

Seacros Holdings Ltd.
P.O. Box 703, Gibsons, BC VON 1VO
886-7334
Lumber, shingles and shakes, panelling

Shawood Lumber
#315 - 811 Beach Avenue, Vancouver, BC V6Z 2B5
669-1911
Common, industrial clears, panelling

Still Creek Forest Products
78 Golden Drive, Coquitlam, BC V3K 6B5
525-2001
All products

Timbex International Limited
842 Cumberland Crescent, North Vancovuer, BC V7P 1Y4
Shingles & shakes, cut stock, picnic tables, cabin logs, panelling, moulding

Tudor Lumber Sales
#202, 8449 Main Street, Vancouver, BC V5X 3M6
324-6022
Lumber

Tyee Timber Products
19822 - 101 Ave., Langley, BC V3A 4P8
888-1443
Remanufacturing, clears, industrial items, patterns

Vancouver Western Wood Products
#204 - 1281 West Georgia, Vancouver, BC V6E 3J7
669-4434
Fencing, panelling, siding, dimension

Vulcan Lumber & Building Supplies
12450 - 109th Ave, Surrey, BC V5V 3J5
580-1818
Finishing, moulding, clears, fencing, pallet stock

W.I. Woodtone Industries
2121 Paramount Crescent, RR #5, Abbotsford, BC V2S 4N5
530-1412
Siding and dimension

Westminster Industries
#205, 15225 - 104th Ave., Surrey, BC V3R 6Y8
588-3133
Rough cut to remanufacturers, fencing, shakes, panelling, siding

Whittall Cedar Sales
#507 - 1541 W. Broadway, Vancouver, BC V6J 1@7
736-8256
Lumber

# *Shakes and shingles operating full steam*

The Globe and Mail

Four months ago, Canadian forest companies were howling in despair because the United States had imposed a stiff duty for five years on imported cedar shakes and shingles.

Mills were shut down across British Columbia in expectation of dwindling sales; Canfor Corp. of Vancouver announced it was closing its shakes and shingles mill and getting out of the business.

But two months ago, Canfor reopened its mill and, like every other B.C. shakes and shingles manufacturer, it is now operating at full capacity.

The shakes and shingles case shows how protectionist tariffs can yield unpredictable results.

Cedar shakes and shingles are used for residential roofing and siding. The biggest market is California.

The U.S. tariff — 35 per cent for 2½ years, 20 per cent for the next two years and 8 per cent for the final six months — was designed to block Canadian imports from the U.S. market. That was supposed to raise the price of shakes and shingles, boosting sales, profit and production by U.S. companies.

That did happen. Canadian producers added the full 35 per cent duty to their prices in the

PRICES — Page B2

# Prices up 35 per cent but sales still booming

● From Page B1

United States and cut back production. Order books of U.S. shingle makers began filling up and their prices rose by about 20 per cent.

Some people who would have bought cedar shakes turned instead to cheaper products, such as aluminum siding or asphalt roofing. But for the most part, market forces overcame the trade barrier.

As demand for cedar shakes and shingles dropped in B.C., so did the demand for raw material. (Canadians stopped shipping cedar logs to the United States after the tariff was imposed.) Log prices came down in B.C. while shake prices in the United States were rising, and a lot of B.C. mills started up again.

Whonnock Shake and Shingle Ltd. — the only major B.C. forest company besides Canfor still making shakes and shingles — had closed its plant in Pitt Meadow, B.C., for three months, but started it again in September.

"Business has really started to pick up and shake prices have gone higher than we thought," said Ralph Kinross, Whonnock's sales manager. "Back in May or June, if somebody said we were going to raise prices 35 per cent, we'd have looked at them like they were crazy. But it's happened."

In the short term, U.S. producers got what they wanted: higher prices, a 15 per cent improvement in profits since the spring, and better production rates. But the United States cannot provide the market with enough logs.

"We just had to hang on until the U.S. ran out of cedar logs," Mr. Kinross said. "Had log prices not gone down in July, we would not have been able to run at all."

The future is far from certain. Whonnock is now carrying a large debt that did not exist in June, and the slow season for house building and renovation is coming.

"We never thought we'd be doing so well now," Mr. Kinross said. "But if the price falls, Canadian mills won't last till the tariff drops off."

THE GLOBE AND MAIL, Tuesday, October 14, 1986

APPENDIX 3 - LUMBER RULING MAY OPEN U.S. CASE ON GRANT SUBSIDIES

**BY JENNIFER LEWINGTON**
Globe and Mail Correspondent

WASHINGTON

U.S. free-trade negotiators will likely use the tariff ruling on Canadian softwood lumber as more ammunition to shoot at a familiar target — Canadian investment incentives.

In its Thursday decision to place a 15 per cent countervailing duty on lumber, the U.S. Commerce Department cited a wide range of federal and provincial government regional development and export promotion programs as unfair subsidies liable for duties.

The department assessed minimal duties of less than 1 per cent against 16 programs, ranging from investment tax credits and export promotion assistance to federal-provincial development agreements.

The department also ruled that provincial stumpage fees, the price set for standing timber, are unfair subsidies and levied a duty of 14.5 per cent. As a result, Canadian lumber exports, once duty-free, now face an over-all tariff of 15 per cent.

One U.S. trade official said yesterday that the 16 incentive programs cited by Commerce are "terribly" relevant to the free-trade talks, although the assessed duties are negligible.

"The fact that grants and loans exist may be a decisive factor in locating a plant," the official said. "It's appropriate to take them into account in the free-trade negotiations."

The subsidy issue will likely be a hot topic during the negotiations. Governments on both sides of the border use a variety of tax gimmicks and other incentives to lure investors.

Canada's menu of programs is more damaging because they are aimed at the U.S. market one way or another, U.S. officials argue.

Even so, U.S. states can outbid Canadian provinces to new investment while the U.S. Government's defence program is an automatic investment magnet for companies.

The department's finding that Canada's timber pricing practices are subsidies under U.S. trade law is the most controversial.

After reading the decision Thursday, Gary Horlick, a former Commerce Department official responsible for the department's decision in 1983 that ruled in Canada's favor on lumber, said: "If you want to define everything as a subsidy you can, but it's not the right way to go."

If the U.S. broadens its subsidy definition, as in the lumber case, he said other countries, like Canada, may use the same approach on U.S. exports.

"The danger is that these principles could be applied to irrigation water and industrial development bonds, and any other government program which is not completely automatic."

In the Thursday decision, the Commerce Department concluded that provincial stumpage programs are a subsidy because they are given to a specific group and at preferential rates.

In justifying its conclusion, the department argued that British Columbia, Alberta, Ontario and Quebec "exercise considerable discretion in allocating their stumpage rights. When the discretion results in the targeting of a specific enterprise or industry, then that program is countervailable."

In justifying its finding of preference, the department selected one of several tests to measure government price discrimination within a jurisdiction.

The department rejected cross-border comparisions, the test urged by the U.S. lumber industry. Instead, the department used another test, the Government's cost of producing a good or service.

However, in publishing its alternative tests for preference several months ago, the department had said that the cost-of-production test was inappropriate for natural resource products.

In another instance, the department appears to contradict its own arguments. On one hand, the department rejects the use of competitively bid timber sales as a benchmark for assessing preferential government practices. Yet, several pages later in the decision, the department says competitive bid sales can be used to calculate the imputed cost of trees, a key factor in the cost-of-production test.

A department lawyer, defending the ruling, conceded "there might be an argument" about the apparent contradiction. However, he said that in the cost-of-production test, competitive bid sales are used as a substitute not a benchmark for determining the degree of preference.

Although only the stumpage practices of four provinces were investigated, the department ruling is national in scope. It was incorrectly reported that only exports from the four provinces will be hit with the duty.

The 15 per cent duty will cover all softwood lumber exports. The department will decide by the time of the final ruling on Dec. 30 whether to exclude certain cedar products and shop lumber as requested by some U.S. importers.

Twenty 20 Canadian companies won exemptions from the Commmerce ruling. They are:

J. D. Irving, Primex Forest Products Ltd., Herb Shaw and Sons Ltd., Bois Daaquam Inc., J. A. Fontaine et Fils Inc., Les Industries Grodin Ltée, Precibois Inc., René Bernard Inc., Conrad Poulin et Fils Ltée, Dead River Ltd., Fraser Inc., Francois Giguere Inc., Devon Lumber Co., Allwood Industries Ltd., Harold's Lumber Manufacturing Ltd., Delta Cedar Products Ltd., Fawcett Lumber Co., Kaloka Forest Products, Namu Forest Products Ltd., and Phoenix Millwork Ltd.

from Globe and Mail,
Saturday,
October 18/86

# Western Red Cedar 2

November 7, 1986

## Dimension — R/L — Green

| | U.S. Funds - Mixed Cars - Net f.o.b. mill** Std&Btr S4S - 75/25 | Std&Btr - RGH-75/25 1-7/8" or Thicker (Std sawn) | | |
|---|---|---|---|---|
| 2x4 | $300 | $310 (300) | 4x6 | $350 (345) |
| 2x6 | 335 | 335 (330) | 4x8 | 365 (350) |
| 2x8 | 335 | 335 (330) | 4x10 | 365 (350) |
| 2x10 | 330 | 340 (330) | 4x12 | 385 (370) |
| 2x12 | 355 | 375 (365) | 6x6 | 395 (380) |
| 4x4 | 340 | 350 (345) | | |

** US prices are duty in.

| Canadian Funds Del. Toronto - FST Extra Std&Btr - 75/25 - S4S - Mixed Cars | |
|---|---|
| 2x4 - 2200# ..... | $465-475 |
| 2x6 - 2300# ..... | 510-520 |
| 2x8 - 2300# ..... | 515-520 |
| 2x10 - 2300# ..... | 510-515 |
| 2x12 - 2300# ..... | 555-560 |
| 4x4 - 2300# ..... | 550-555 |

## Boards — R/L — Green

U.S. Funds - Mixed Cars**

| | S1S2E Std&Btr | S1S2E 100%STK | Clear D&Btr* | Channel Sidings Std&Btr-nps | STK/25%QBtr | STK |
|---|---|---|---|---|---|---|
| 1x4 | $305 | $360 | $675 | $--- | $--- | $--- |
| 1x6 | 330 | 440 | 825 | --- | 470 | --- |
| 1x8 | 335 | 440 | 825 | 365 | 480 | 495 |
| 1x10 | 330 | 440 | 850 | 365 | 480 | 495 |
| 1x12-3/4 | 365 | 440 | 875 | | | |
| 1x12-7/8 | --- | | | | | |

| U.S. Funds - Mixed Cars Tight Knot S1S2E & Green Bevel | |
|---|---|
| 1x12 S1S2E-7/8-STK..... | $--- |
| 3/4x8 Bevel-TK-25%Q... | 380 |
| 3/4x10 Bevel-TK-25%Q... | 380 |
| 11/16 Rgh-TK-25%Q..... | 330 |
| 5/8x8 Std&Btr-nps..... | 295 |

*3/4" pullouts. For R/L packaging and paperwrap, add $30 - $35.
** US prices are duty in.

## Sidings & Panels

### Clear Panel

| A&Btr - 10/15% B - U.S. Funds** 3'& Lgr - Smooth Face V-Joint | |
|---|---|
| 1x4 (11/16) | $900 |
| 1x6 (11/16) | 1360 |
| 1x8 (11/16) | 1300 |
| 1/2x4 (7/16) | 820 |
| 1/2x6 (7/16) | 925 |

** US prices are duty in.

### Bevel Siding

| U.S. Funds** | VG Clr | A | B |
|---|---|---|---|
| 1/2x6 | $730 | $705 | $590 |
| 1/2x8 | 735 | 705 | 590 |
| 3/4x8 | 825 | *810 | — |
| 3/4x10 | 940 | *930 | — |

*A&Btr/10-15%B

** US prices are duty in.

## Shingles & Shakes

### Shingles - U.S. Funds

| | 18"-158# Perfections* | 16"-144# Five-X* | 24"-192# Royals |
|---|---|---|---|
| #1 | $49.25(66.50) | $44.50(60.50) | $59.00 |
| #2 | 23.00(31.00) | 24.00(32.25) | 26.00 |
| #3 | 11.75(16.00) | 11.75(16.00) | --- |

* Piggybacks. (35% duty added)

### Shakes

HS&RS - 1/2x24-280# - Piggyback $47.25 (64.00)
HS&RS - 1/2x24-280# - to Calif. 46.75 (63.00)
HS&RS - 3/4x24-350# - Piggyback 53.00 (71.50)
HS&RS - 3/4x24-350# - to Calif. 52.00 (70.00)
HS - 24"Tapers-260# - $75.00 (Cdn)
Rebutt/Rejoint- 18 - 33.00 (44.50)

## Inland Red Cedar - U.S. Funds - KD

| US$ - KD | #3&Btr/nps S4S | S1S2E | #4/nps S4S | S1S2E |
|---|---|---|---|---|
| 1x4 | $250 | $305 | $ 90 | $ 75 |
| 1x6 | 500 | 500 | 105 | 90 |
| 1x8 | 495 | 495 | 115 | 110 |
| 1x10 | 445 | 450 | 165 | 165 |
| 1x12 | 430 | 430 | 190 | 190 |

## Idaho White Pine

| | Sterling | Standard | Utility |
|---|---|---|---|
| 1x4/1x12 | $930-940 | $510-520 | $330-340 |

Toronto; Cdn Funds; FST extra; $5.49/cwt; 1800#.

APPENDIX 5 -

## Presidential Documents

**Memorandum of May 23, 1986**

### Western Red Cedar Shakes and Shingles Import Relief Determination

**Memorandum for the United States Trade Representative**

Pursuant to Section 202(b)(1) of the Trade Act of 1974 (19 U.S.C. 2251(b)(1)), I have determined the action I will take with respect to the report of the United States International Trade Commission (ITC), transmitted to me on March 25, 1986, concerning the results of its investigation of a petition for import relief filed by the Northwest Independent Forest Manufacturers on behalf of the domestic industry producing wood shakes and shingles, provided for in item 200.85 of the Tariff Schedules of the United States.

After considering all relevant aspects of the case, including those set forth in Section 202(c) of the Trade Act of 1974, I have determined that provision of import relief in the form of a tariff for up to 5 years is in the national economic interest. The tariff will apply to all U.S. imports of western red cedar shakes and shingles. The additional duty will be 35 percent ad valorem for the first 30 months of the period, 20 percent ad valorem for months 30 through 54, and 8 percent ad valorem for months 54 through 60. This 5-year relief program should be sufficient to enable the domestic producers of red cedar shakes and shingles to adjust to competition during the relief period.

In conjunction with providing import relief, I hereby direct you to request that the ITC advise me of the probable economic effect on the domestic industry of the termination of import relief after 30 months. This advice is to include a review of the progress and specific efforts being made by the domestic producers of western red cedar shakes and shingles to adjust to import competition. I also direct you to request, on my behalf, advice regarding termination of relief from the Secretaries of Commerce and Labor. The ITC, Commerce, and Labor advice is to be provided to me, through you, 3 months prior to the expiration of the 30-month period. It is my intention to continue relief for the entire 5-year period if general market conditions continue to warrant relief and if the domestic producers have begun to make reasonable progress toward adjustment during the first 30-month period.

As required by Section 203(e)(1) of the Trade Act of 1974, this tariff will be implemented by Presidential Proclamation no later than June 7, 1986, which is the 15th day after the date of this determination.

This determination shall be published in the Federal Register.

Ronald Reagan

THE WHITE HOUSE,
*Washington, May 23, 1986.*

[FR Doc. 86-12078
Filed 5-27-86; 9:08 am]
Billing code 3195-01-M

APPENDIX 6 - **Products** SECTION from D. Minore, 1983. Western Red Cedar - a Literature Review

## Uses and Properties

Western redcedar products have been important since prehistoric times. North American Indians, particularly tribes living along the coasts of Washington and British Columbia, used redcedar in many ways. Large logs were carved into totem poles and hollowed out to make huge ocean-going canoes. The redcedar logs were also split into wide planks used in building large timber frame structures that were often 15 m (50 ft) or more square (Vastokas 1969). Recent excavations of buried structures made by Indians have uncovered redcedar planks thought to be 6,000 to 10,000 years old (Sharpe 1974). Bark from young trees was used by the Indians to make baskets, ropes, blankets, mats, clothing, and thatch (see Sargent 1933, Bowers 1956, Dallimore and Jackson 1967, Bolsinger 1979). The flexible young branches were also used in making baskets. Thin twigs were woven into whaling ropes, and thicker ones were used for arrows (Edlin 1968). The roots were used for fishhooks (Dallimore and Jackson 1967).

Modern society also uses western redcedar in a variety of products. The wood is valued for canoe and boat construction, and redcedar is still being used to build timber frame structures — as exterior siding, shingles, sashes, doors, window frames, and interior finish (Forest Products Laboratory 1955, Wood 1959). In addition, western redcedar is used in utility poles, fenceposts, piling, paper pulp, clothes closets and chests, caskets, crates, boxes, beehives, rain gutters, and fish-trap floats (Butler 1949, Viereck and Little 1972, Sharpe 1974). A complete list would include many other products, for the wood is suitable for many uses.

Western redcedar wood is nonresinous, light, and easy to work (Forest Products Laboratory 1955, Wood 1959). It has exceptional dimensional stability and is a good thermal insulator (Forest Products Laboratory 1955, Tickle 1963). Redcedar wood glues easily, particularly with nonresin glues (Forest Products Laboratory 1955). Although naturally durable, it is difficult to impregnate with artificial preservatives — even by pressure processes (Titmuss 1965).

The ease of splitting redcedar is an advantage in the manufacture of handsplit shakes, but a disadvantage when trees are felled on rough hills and yarded with heavy machinery. Breakage, splitting, and shattering are often severe (McBride 1959). The wood is weak when used as a beam or post and low in shock resistance (Forest Products Laboratory 1955). The low density of redcedar was associated with poor fire resistance in the British standard fire-propagation test (Hall and Dell 1970). It is a soft wood that is extremely sensitive to marring (Packee 1976). The density and hardness of western redcedar can be increased threefold by using heat and pressure, without the addition of chemicals, but this is only a laboratory procedure of no commercial importance (Research News, Ottawa 1962a).

Western redcedar is one of the poorest woods for nail- and screw-holding capacity. It is also poor for bolt-holding and is one of the weakest woods for withstanding connector loads (see Forest Products Laboratory 1955, Hokhold 1965). Special ring-shanked nails improve the nail-holding capacity of redcedar (Lee and Lord 1960), and increasing the screw lengths by 0.6 cm (1/4 in) improves its screw-holding properties enough to equal those of western hemlock, Scotch pine, and Norway spruce (British Columbia Lumber Manufacturers Association, n.d.)

Dry western redcedar takes and holds stains, paints, enamels, and clear finishes very well (West Coast

Lumber Trade Extension Bureau 1927, Wood 1959, Jones 1966). It ranks with redwood as the best paint substrate available in North American woods (Gardner 1963). Lack of extreme differentiation between springwood and summerwood, plus low summerwood swelling and the resulting lack of raised grain, seem to be responsible (see Brown 1957, MacLean 1970). Blistering is serious where free water (not just water vapor) is present behind the paint film in western redcedar, however; more serious than in Douglas-fir, Alaska-cedar, white pine, red pine, or spruce (Veer and King 1963). Extractive globules became concentrated on the paint surface in the 100-percent humidity maintained by Veer and King. Extractive bleedthrough can be a problem (Forest Products Laboratory 1966, MacLean 1970).

One of the best clear finishes for western redcedar wood is a tung oil modified, phenolformaldehyde-resin-based varnish (Oliver 1957). The best pigmented, penetrating stain seems to be the Forest Products Laboratory natural finish (60 percent linseed oil, 5 percent pentachlorophenol, 10 percent pigment, 0.3 percent zinc stearate, 1.0 percent wax, and 3.7 percent volatiles); the best water-soluble inorganic salt finishes contain acid copper chromate, chromated copper arsenate, or copper-pentachlorophenol (Grantham et al. 1976). When left unfinished, western redcedar weathers gray (Wood 1959) and resists decay, but erodes appreciably faster than redwood, Douglas-fir, Engelmann spruce, or ponderosa pine (Feist and Mraz 1978). Both western redcedar and redwood weathered better than Monterey pine, alpine-ash, Brisbane boxwood, or King-William-pine in Australia (Woodhead 1969). Redcedar wood is quite resistant to corrosion by hydrochloric acid but is less suitable than baldcypress or longleaf pine for use in contact with acids (American Wood Preservers Association 1946).

## Prices

The many uses and excellent properties of western redcedar products have increased the demand for them in recent years. This increasing demand has been accompanied by accelerating price increases. Both consumption rates and prices have increased more rapidly for western redcedar products than for products of most other west coast woods (Bolsinger 1979). Western redcedar and Alaska-cedar commanded average round-log values higher than any other Alaska tree species in 1971 (Farr and LaBau 1971).

In western Washington and northwestern Oregon, the average price paid for all western redcedar logs increased from $57.30 per thousand board feet in 1965 to $320.80 per thousand board feet in 1977 — an average annual increase of 15.4 percent compared with average annual price increases of about 12 percent for Douglas-fir and western hemlock during the same period (Bolsinger 1979). The accelerating nature of these price increases is emphasized by Ruderman's (1978) calculations for 1975-77; average annual increases in log price were 35.1 percent for western redcedar, 20.0 percent for Douglas-fir saw logs, and 13.2 percent for western hemlock. As the estimated annual harvest of western redcedar in the United States for 1975 to 1976 was 950 million board feet (Bolsinger 1979), such price increases represent very large sums spent for redcedar products.

Accelerating price increases and an increasing demand for redcedar products may stimulate greater use of defective western redcedars like those found in the extensive stands of decadent cedar and hemlock in interior British Columbia. Dobie (1976) concluded that rehabilitation of these decadent stands could be profitable only at very low discount rates for short rotations on good and medium sites, but subsequent price increases may provide economic alternatives.

## Lumber

Lumber was the chief western redcedar product in Oregon, Montana, and Idaho in 1976 (Bolsinger 1979). Most redcedar logs used for lumber manufacture are acceptable in terms of eccentricity, sweep, taper, and shake (see Packee 1976). Redcedar lumber cut from these logs is easy to kiln dry, but boards from the butt log (Desch 1948) and thick planks (Forest Products Research Board 1950a) sometimes collapse during drying The cell walls are distorted or obliterated, and redcedar lumber does not recover after collapsing (Tiemann 1941). Predicting collapse from the appearance of a log is difficult or impossible, but collapse is associated with higher than normal extractive content (Meyer and Barton 1971, Barton 1975). Most redcedar logs subject to collapse seem to come from low or swampy ground (Guernsey 1951). Guernsey observed that heavy boards were more likely to collapse than light ones. He recommended air drying before kiln drying or, if this is impossible, initial kiln temperatures that do not exceed 49 °C (120 °F).

Kiln temperatures above 100 °C (212 °F) with three to six times shorter drying times have been tested, but they resulted in nonuniform moisture content and a 5-percent loss of bending strength in western redcedar (Ladell 1953). Less severe, moderately accelerated drying schedules can be successfully used with lightweight boards of less than 45-percent moisture content (Salamon and Hejjas 1971). Kiln drying does not destroy the heartwood extracts of redcedar, but it makes them more soluble (Sowder 1927). Kiln corrosion should be considered when western redcedar is dried, because the thujaplicins are steam-distillable; they sometimes condense on metal kiln parts and corrode them (Barton 1972).

Extractive-caused metal corrosion occurs even without the high temperatures associated with kiln drying. The zinc and lead used in roof gutters and valleys are sometimes corroded by rainwater extracts from western redcedar shingles or shakes (Forest Products Research Board 1950b). Iron, steel, copper, and brass fasteners (such as nails, screws, hinges) often corrode when in contact with redcedar lumber (see Campbell and Packman 1944, Farmer 1962, Titmuss 1965). The carbide-tipped saws and knives used in lumber manufacture also are corroded, dulling much sooner when used on unseasoned western redcedar than when used on other woods (Kirbach and Chow 1976). Recommended remedies include substituting another metal for the cobalt in tungsten carbide and using aluminum or stainless steel nails, screws, and fittings (Research News, Ottawa 1962b).

Where lumber is used under moist conditions, as in water-cooling towers, western redcedar seems to be less suitable than redwood (see Western Australia Forests Department 1961). Nevertheless, untreated redcedar lumber had a service life of about 18 years in Canadian cooling towers (Roff 1964). When water-repellent treatments were applied to western redcedar, waxes and wax solutions gave the most durable results (Gray and Wheeler 1959). Western redcedar responded better than eastern redcedar or baldcypress to waxing and staining treatments used in the preparation of pencil slats (Greaves and Harkom 1949).

Redcedar is the most important western species used for siding in the United States and Canada (Panshin and deZeeuw 1970), and it shows promise as a homegrown lumber species in Great Britain (Priest 1974). It is suitable for pattern making in foundries (Hale 1954). Redcedar makes excellent horticultural boxes (Moore and Bryan 1946) and is used in greenhouse construction (Syrach Larsen 1943). Western redcedar is unsuitable for apple boxes, however; the apples absorb volatiles from the wood and spoil (Ministry of Agriculture, Belfast, n.d.; Colhoun et al. 1961; Colhoun and Park 1963; Loughnane and Gallagher 1963).

## Shakes and Shingles

Shakes and shingles are the chief western redcedar products in Washington, and British Columbia exported 3,294,000 squares in 1978.[1] Recent increases in shake and shingle production have been greater than the production increases in other redcedar products (Bolsinger 1979). Even before those increases, more than 95 percent of all wooden shingles manufactured in the United States were made from western redcedar (Brown and Panshin 1940). Attractive appearance, durability, lightness, and superior insulation probably are responsible for the popularity of redcedar as a roofing material. The insulating properties of 2.54 cm (1 in) of western redcedar wood are equal to 30 cm (12 in) of concrete or 19 cm (7.5 in) of brick or clay tile (O'Hea 1947).

Three types of redcedar shakes are manufactured: Straight split, taper split, and handsplit-resawn. All come in random widths of 10 to 30 cm (4 to 14 in). Lengths range from 46 to 81 cm (18 to 32 in), but the 61-cm (24-in) length is most common (The Lumberman 1957). Straight-split and taper-split shakes are both handsplit from redcedar blocks, but the blocks are reversed every other time for taper-split shakes. Handsplit-resawn shakes, which account for most of the shake production, have a coarse-textured split surface on one side and a smooth sawn surface on the reverse side (Munger 1970).

Only old, slow-growing, straight-grained, relatively knot-free western redcedar trees seem to be suitable for shake manufacture. Good shake material has 35 to 50 annual rings per inch (14 to 20 rings per cm). At least 245 years are required to produce a tree of suitable size for such material, and the shake industry is supported by redcedar trees that are 500 to 1,500 years old (Munger 1970). Such trees probably constitute a nonrenewable resource when considered in the scale of human time (see Munger 1970, Mitson and Holman 1975).

Younger trees may be suitable for redcedar shingles (Packee 1976). The two types of western redcedar shingles are slash grain and edge grain. Edge-grain shingles do not curl and are more durable (O'Hea 1947). Although untreated redcedar shingles may last for 25 years in Pennsylvania (Fergusson 1938) and 50 years in Washington (see Grondal 1913), they are less durable than redwood shingles in the wetter parts of Honolulu (Skolmen 1968). Leaching of the water-soluble heartwood extractives in wet conditions may be responsible (see Cserjesi 1976), but the low pitch of modern roofs also reduces durability.

Pressure impregnation with copper, chromium, and arsenic preservatives improves the durability of redcedar shingles (Smith 1964b). Impregnation with leach-resistant fire retardants makes the shingles more fire resistant (St. Clair 1969, Holmes 1971, Juneja 1972). Amino-resin-forming compounds are effective retardants (King and Juneja 1974).

[1] This statistic was obtained from the Council of Forest Industries of British Columbia, Vancouver. A "square" is the amount of shingles or shakes required to cover an area of 9.29 $m^2$ (100 $ft^2$), exclusive of overlap.

High-temperature kiln-drying schedules can be used to bring unbundled western redcedar shingles from green to shipping weight in less than 2 hours (see Salamon 1960). Shingle durability is not appreciably affected by these high-temperature schedules (MacDonald and MacLean 1965).

## Poles and Piling

Good form, large size, light shipping weight, easy climbing-spur penetration, and durability make western redcedar an excellent species for pole production, but it has a tendency to crush when used as piling (Brown and Panshin 1940). Redcedar poles taper more than southern pine or Douglas-fir poles (Bohannan et al. 1974). They are remarkably consistent in strength, however, showing no significant differences between geographic locations, elevations, or seasoning treatments (McGowan and Smith 1965).

Western redcedar poles constitute a plentiful renewable resource in British Columbia. Anderson (1961) estimated a provincial supply of about 121 million poles. Without considering annual growth, he forecast a pole supply of 300 years at the 1961 cutting rate of 400,000 poles per year. Approximately 200,000 poles were cut each year in the United States, which consumed about 400,000 redcedar poles annually (Anderson 1961).

Average-size western redcedar poles with sapwood less than 2.54 cm (1 in) thick should last about 12 to 17 years without treatment (Forest Products Laboratory 1955). More than half the untreated redcedar telephone poles on the Island of Hawaii were still serviceable after 20 years, however (Boone 1965). When in contact with the ground, they have a service life proportional to their diameter, not their cross-sectional area (Pursiow 1962).

The service life of redcedar poles has been increased through several preservative treatments. Spraying freshly peeled green poles with urea minimized the checking that sometimes occurs during drying (West Coast Lumberman 1941). The dry poles were pressure treated with creosote and creosote-coal tar solutions during the 1940's (American Wood Preservers Association 1943, 1944). Hot- and cold-bath treatments with creosote and pentachlorophenol were then tried (see Colley 1946). Preservative penetration was often poor in western redcedar poles, however, and it varied with position and wood condition within a single pole (Jurazs and Wellwood 1965). Fortunately, the portions with poorest penetrability seemed to have the highest extractive content and least need for preservative treatment. Nonpressure treatment — such as butt-soaking or soaking the entire length of the pole — is common now. Pressure treatments are less used — the redcedar poles tend to become oversaturated (Randall and Sutherland 1974).

Redcedar poles are seldom retreated now, but several formerly used procedures for re-treating in-service poles are of historical interest. One method was machine-shaving the sapwood and subsequently soaking the shaved pole in creosote (Lyon 1939). A somewhat similar procedure was used on redcedar bridge piling. After removing soil from around the affected portion, decayed wood was scraped off and the piling treated with a gelatinous suspension of NaF dinitrophenol and potassium dichromate (Railway Track and Structures 1955). Aboveground sap rot in redcedar poles has been treated by spraying with a 10-percent solution of pentachlorophenol (Graham and Wright 1959, Scheffer and Graham 1973).

Green or wet western redcedar power poles — particularly wet poles that have been in saltwater — may have low electrical resistances that are potentially hazardous to line workers (see Katz and Miller 1963, Breeze and Vitins 1965).

## Pulp

The low density of western redcedar is the most serious handicap to its increased use in pulping (Wethern 1959). Pulp is produced and sold by weight, but the logging and lumber industries work by volume. Because a given volume of western redcedar contains only 77 percent as much wood by weight as the same volume of western hemlock and only 66 percent as much as the equivalent volume of Douglas-fir, the redcedar produces less pulp (Wethern 1959). Low lignin and extractive contents are highly desirable for chemical pulping processes — but western redcedar wood has relatively high contents of both (see Packee 1976).

The stringy redcedar bark is difficult to remove with standard debarking equipment. Chemical debarking with sodium arsenate has been tried successfully (DeMoisy 1952); ingrown bark is difficult to remove by any debarking technique, and it may create problems in some chemical pulping processes. Pilot-plant studies indicated that redcedar bark could be processed satisfactorily, however, and even whole-log chipping was possible (Thomas and Davis 1974).

The sulfate process is most frequently used to produce pulp from western redcedar. Yields are lower in sulfate than sulfite pulping, increasing the disadvantage of redcedar density mentioned earlier (Wethern 1959). The acidic constituents of western redcedar wood consume extra alkali, further reducing profits in a sulfate pulping operation (see Thomas and Davis 1974). Redcedar extractives corrode the steel ordinarily used in digesters and recovery equipment, sometimes reducing digester life by 50 percent compared with digesters used for western hemlock or Douglas-fir

(Wethern 1959, Thomas and Davis 1974). The life of evaporator tubes may be reduced by 80 percent (see Gardner 1963). Thujaplicins, a phenolic constituent, or both probably are responsible (British Columbia Lumberman 1953, MacLean and Gardner 1953a). Redcedar pulp drains poorly, sometimes restricting production even further (Thomas and Davis 1974). Its color constitutes a final handicap (Troxell 1954); redcedar pulp bleaches with difficulty (Isenberg 1951).

Some handicaps of redcedar pulping have been turned into advantages by skillful manipulation of the sulfate process, and redcedar has some favorable pulping characteristics. For example, adding 3 to 5 percent sodium sulfide to the cooking liquor offsets the deleterious effects of high alkalinity and improves both the yield and strength of redcedar pulp (Christiansen et al. 1957). Western redcedar requires a shorter sulfate-process cooking time than other British Columbia species (Wilson et al. 1960). It has finer fibers than western hemlock, Douglas-fir, or southern pine and makes a dense sheet with good opacity (Murray and Thomas 1961). Indeed, bleaching sulfate pulp made from western redcedar sawdust yields a product with an opacity comparable to hardwood pulps (Proctor and Chow 1976). The fine fibers tend to be shorter than those in Douglas-fir pulp (Heinig and Simmonds 1948, Graff and Isenberg 1950), but western redcedar pulp does not differ chemically from the sulfate pulps of Douglas-fir, western hemlock, black spruce, or loblolly pine (Lewis et al. 1950).

Physically, redcedar pulp has several desirable attributes. Unlike Douglas-fir, western hemlock, or Pacific silver fir, western redcedar produces very good kraft (sulfate) pulp (see Packee 1976). This pulp has high bursting, folding, and tensile strengths that offset its low tearing strength (see Bray and Martin 1947, Holzer and Booth 1950, Wethern 1959, Wilson et al. 1960, Murray and Thomas 1961). Western redcedar pulp has a high specific surface area (Browning and Baker 1950). Its cellulose characteristics are similar to those of western hemlock and loblolly pine pulps (see Clark 1950, Heuser et al. 1950). Sulfate pulp made from redcedar bark has lower bursting and tensile strengths, higher tearing strength than that made from wood (Thomas and Davis 1974).

Although sulfite pulp yields are higher than sulfate (kraft) yields for western redcedar (see Packee 1976), redcedar requires a longer cooking time and more chemicals than western hemlock in the sulfite process. The resulting low-brightness cedar pulp drains poorly (Wethern 1959). Redcedar sulfite pulp is dark and difficult to bleach (Isenberg 1951), and the use of a bisulfite cooking liquor with a high magnesium content seems necessary (see Keller and McGovern 1945). The bursting strength of western redcedar sulfite pulp is relatively high in comparison with the sulfite pulps of other species. Its tear strength is relatively low (see Holzer and Booth 1950).

Mechanical (groundwood) pulping processes are not practical for western redcedar (Wethern 1959). The resulting product has very good strength and printing qualities but poor brightness (see Packee 1976). Semichemical redcedar pulps may be useful in making paperboard (McGovern et al. 1951).

### Veneer and Plywood

Western redcedar is highly suitable for decorative face veneer, but unsuitable for the inner plies of decorative veneer or for use in container material (see Packee 1976). Packee rated redcedar veneer logs as excellent when assessed for freedom from reaction wood, resin or gum, and bark pockets. Redcedar logs were rated "acceptable" when assessed for freedom from decay, knots, and wet wood.

Western redcedar plywood panels can be made by slicing the logs and cold pressing the resulting veneer (West Coast Lumberman 1946). Where hot pressing is used, high glue spreads and press temperatures of 270°F (132°C) or lower have been recommended to prevent blistering (Carstensen 1961). Although highly rated for decorative plywood (Lutz 1972), redcedar is too weak for construction grade structural plywood (Palka and Warren 1977).

### Waste Utilization

Redcedar lumber, shake, and shingle manufacture produces tremendous quantities of waste material. Logging residue in some clearcut redcedar stands may average 238 $m^3$/ha (3,400 $ft^3$/acre) (Howard 1973). The residues produced annually from cedar sawmills in Oregon, Washington, and British Columbia were estimated to be 1 to 1.5 million ovendry tons (907 to 1361 million kilograms) in 1968 (Scroggins and Currier 1971). Annual residues from shake and shingle mills were estimated to be 700,000 ovendry tons (635 million kilograms).

The average amounts of mill residues produced in western redcedar log processing are listed in table 5. Shake manufacture produces the least amount of waste, shingle manufacture the most. In shingle manufacture only a small portion of the original tree is marketed; slash and mill residues account for most of the original standing volume.

Much of the mill residue is suitable for pulp production (Bray and Martin 1947). It can also be used in fiberboard production if treated properly. Boards made from western redcedar bark alone tend to be unacceptably weak (see Schwartz 1949, Clermont and Schwartz 1948, Stewart and Butler 1968, Maloney 1973), but ozone treatment increases the

bark's internal bond strength (Chow 1977b) and the addition of 10 percent sulfite pulp or sulfite screenings makes bark boards stronger (British Columbia Lumberman 1948). Boards made from wood components of the residue were acceptably strong (King and Bender 1951, 1952). Those made from sawdust, shingle tow (a stringy waste product resulting from shingle manufacture), or both were not (see Forest Products Laboratory, Canada 1949; King and Bender 1951, 1952).

Of all west coast conifer sawdusts, that of western redcedar is the only one that can be made into high quality, opaque pulp comparable to the hardwood sulfate pulps used in high-quality papers (Proctor and Chow 1976). It can be differentiated from the sawdusts of Douglas-fir, western hemlock, true firs, and the spruces with a color test using chloroform and ferric chloride (Barton 1973a). Redcedar sawdust apparently decomposes more rapidly than Douglas-fir or western hemlock sawdust (see Bollen and Lu 1957). When not leached, it inhibits seed germination and seedling growth (Newton 1953) and damages Douglas-fir seedling roots (Krueger 1968). Redcedar sawdust makes a satisfactory rooting medium, however, when it is leached to remove the water-soluble extractives and mixed 3:1 with peat (Briggs 1973). Perhaps the most novel use of redcedar sawdust was as fill material where the trans-Canada highway crossed bogs and marshes (Southern Lumberman 1961).

Shingle tow has been used since about 1915 to keep tree seedlings moist during shipment. Krueger (1963, 1968) studied its effects on seedling survival and growth. He found that the thujaplicin extractives present in shingle tow were damaging to Douglas-fir seedlings but considered that the use of shingle tow was unlikely to cause heavy losses.

**Table 5 — Average amounts of mill residues produced in processing of western redcedar logs[1]**

| Product | Coarse residues | Fine residues | Total waste |
|---|---|---|---|
| | | *Percent of log volume* | |
| Lumber | 18 | 19 | 37 |
| Shakes | 14 | 14 | 28 |
| Shingles | 14 | 47 | 61 |

[1]From McBride (1959), Gardner (1963), Scroggins and Currier (1971).

## Extractives

Shingle tow, sawdust, and coarse residues are probably the best raw materials for producing most redcedar extractives (Wethern 1959). $\beta$-thujaplicin accumulates in digesters, evaporators, and kilns during redcedar processing, however, where it is readily available in commercially usable quantities (Trust and Coombs 1973). Potential uses of these extractives include insecticides, fungicides, antibiotics, chelating agents, catalysts, and perfumes (Wethern 1959).

Cedar leaf oil has been used in perfumes, insecticides, medicinal preparations, veterinary soaps, shoe polishes, and office deodorants (Forestry Abstracts 1965, Barton 1973b). It is a strongly scented, viscous liquid containing thujone, pinene, borneol, and borneol esters (Cochrane 1951, Bender 1963). Cochrane and Bender described the distillation procedure used to obtain this product. Steam extraction of freshly cut western redcedar leaves yielded 2.5 percent oil, based on dry leaf weight (Cochrane 1951).

Extractives probably were important in the successful production of fuel logs from wet redcedar sawdust (Gardner 1963). They were used to make a boiler-water additive that removed boiler scale and controlled foaming (British Columbia Lumberman 1951, McBride 1959). Water-soluble redcedar extractives have also been used in the electrolytic refining of lead (British Columbia Lumberman 1959). Even the lignin residue of *Poria asiatica* butt rot in western redcedar has been used — as a filler and extender in plywood glues (MacLean and Gardner 1953b).

Most of the extractives in western redcedar heartwood are formed from precursors at the sapwood/heartwood boundary (Swan et al. 1969). For example, nezukone is converted to thujaplicin at this boundary by hydroxylation of the tropone ring (Swan and Jiang 1970). The formation of different amounts of each extractive in older heartwood may be the result of changes in metabolism (more hydroxylation, less methylation) with aging (Hillis 1968).

## REFERENCES CITED


American Wood Preservers Association. 1943. Report of committee 5-5-1 on the pressure treatment of poles. Proc. Am. Wood Preserv. Assoc. 39:43-53.

American Wood Preservers Association. 1944. Report of committee 5-5-1 on the pressure treatment of poles. Proc. Am. Wood Preserv. Assoc. 42-255-265.

American Wood Preservers Association. 1946. Report of committee 7-10. Diversified uses of treated wood. Proc. Am. Wood Preserv. Assoc. 42:355-265.

Anderson, I.V. 1961. Western redcedar poles from British Columbia. J. For. 59(1):14-16.

Barton, G.M. 1972. How to prevent dry kiln corrosion. Can. For. Ind. 92(4):27-29

Barton, G.M. 1973a. Chemical color tests for Canadian woods. Can. For. Ind. 93(2):57-60, 62.

Barton, G.M. 1973b. Wood chemistry of western conifers - questions and answers. West. For. Prod. Lab., Can. Inf. Rep. VP-X-106, 28 p. Vancouver, BC

Barton, G.M. 1975. Western conifer extractive chemistry aids the technologist. Dep. Enviorn. Can. For. Serv., West. For. Prod. Lab. Inf. Rep. VP-X-142, 18 p. Vancouver, BC

Bender. F. 1963. Cedar leaf oils. Can. Dep. For. Publ. 1008, 16 p. Ottawa.

Bohannan, B., H. Habermann, and J.E. Lengel. 1974. Taper of wood poles. USDA For. Serv. Gen. Tech. Rep. FPL-2 9 p. For. Prod. Lab., Madison, Wis.

Bollen, W.B. and K.C. Lu. 1957. Effect of Douglas fir sawdust mulches and incorporations on soil microbial activities and plant growth. Soil Sci. Soc. Am. Proc. 21(1):35-41.

Bolsinger, C.L. 1979. Western redcedar - a forest resource in transition. USDA For. Serv. Resour. Bull. PNW-85, 24 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Boone, R.S. 1965. Service life of telephone poles on the island of Hawaii. USDA For. Serv. Res. Note PSW-96, 6 p. Pac. Southwest For. and Range Exp. Stn., Berkeley, Calif. [For. Abstr. 27:6792].

Bowers, N.A. 1956. Cone-bearing trees of the Pacific coast. 169 p. Pac. Books, Palo Alto, Calif.

Bray, M.W. and J.S. Martin. 1947. Sulfate pulping of Douglas fir, western hemlock, Pacific silver fir, and western red cedar logging and sawmill waste. USDA For. Serv. Rep. R1641, 10 p. For. Prod. Lab., Madison, Wis.

Brown, H.P. and A.J. Panshin. 1940. Commercial timbers of the United States. Their structure, identification, properties, and uses. 554 p. McGraw-Hill Book Co., Inc., New York and London.

Breeze, J.E. and J. Vitins. 1965. Effects of salt and fresh water soaking on electrical resistance of powerline poles. For. Prod. J. 15(12):484-487.

Briggs, B.A. 1973. Research at the nursery level. II. Cedar sawdust as a rooting medium. Int. Plant Propag. Soc. Comb. Proc. 23:58-62.

British Columbia Lumber Manufacturers Association [n.d.] The screw holding properties of western red cedar. B.C. Lumber Manuf. Assoc. Inf. Bull. 9, 4 p. [For. Abstr. 27:1243. 1966]

British Columbia Lumberman. 1959. Cedar in led refining. B.C. Lumberman 43 (July):44, 46.

British Columbia Lumberman. 1953. New Uses for cedar. B.C. Lumberman 37(3):75, 84-85.

British Columbia Lumberman. 1951. Boiler Compound produced in B.C. from cedar waste. B.C. Lumberman 35(9):84.

British Columbia Lumberman. 1948. Structural Boards from werstern red cedar bark. B.C. Lumberman 32(2):91.

Brown, F.L. 1957. Swelling of springwood and summerwood in softwood. For. Prod. J. 7(11):416-424 [For. Abstr. 19:3415]

Browning, B.L. and P.S. Baker. 1950. The characteristics of unbleached kraft pulps from western hemlock, Douglas fir, western red cedar, loblolly pine, and black spruce. IV. The specific surface areas of the pulps and the changes on beating. Tappi 33(2):99-101.

Butler, C.G. 1949. Bee-hives. Minist. Agric., Lond. Bull. 144, 2 p. [For. Abstr. 12:3257]

Campbell, W.G. and D.F. Packman. 1944. Wood as a causal factor in the corrosion of metals. Wood 9(5):99-101.

Carstensen, J.P. 1961. Gluing characteristic of softwood veneers and secondary western hardwood. For. Prod. J. 11(7):313-315.

Chow, S. 1977b. Properties of bark boards made with ozone treatment. Wood Sci. 9(3):124-129. [For. Abstr. 38, p. 507]

Christiansen, C.F., J.S. Hart, and J.H. Ross. 1957. Sulphidity as a variable in the pulping of western red cedar: the effect of the Na2S wood ratio on pulp properties. Pulp and Pap. Mag. Can. 58(1):103-109. [For. Abstr. 18:3490]

Clark, G.L. 1950. The characteristics of unbleached kraft pulps from western hemlock, Douglas fir, western red cedar, loblolly pine, and black spruce. VI. The orientation of cellulose chains in pulp fibres as measured by x-ray diffraction. Tappi 33(2):108-110.

Clermont, L.P. and H. Schwarta. 1948. Studies on composition of bark; utilization for structural boards. Paper Trade JH. 126(19):57-60.

Cochrane, J.A. 1951. Cedar leaf oil extraction. J. For. Prod. Res. Soc. 1(1):120-123.

Colhoun, J. G. McElroy, and P.J. WArd. 1961. Wastage of apples in relation to the wood used for storage boxes. Plant Pathol. 10(3):116-118. [For. Abstr. 25:1362)

Colhoun, J. and D. Park. 1963. Damage to stored apples caused by Thuja wood. Plant Pathol. 12(1):45-46.

Colley, R.H. 1946. Non-pressure hot and cold bath treatments of lodgepole pine poles with creosote, and with pentachlorophenol petroleum distillate solution - with discussion. Proc. Am. Wood Preserv. Assoc. 42:282-296.

Cserjesi, A.J. 1976. Performance of preservatives of treated experimental shake roofs. For. Prod. J. 26(12):34-39.

Dallimore, W., and A.B. Jackson. 1967. A handbook of Coniferae, including Ginkgoaceae. 4th ed., rev. by S.G. Harrison, 729 p. St. Martin's Press, New York.

Desch, H.E. 1948. Softwod cedars. Wood 13(3):74-76.

DeMoisy, R.G. 1652. Progress report on chemical debarking. Wash. For. Prod. Inst. Circ. 18 4 p. Seattle. [For. Abstr. 13:3870].

Dobie, J. 1976. Economics of decadent cedar-hemlock utilization and rehabilitaiton in the B.C. interior. West. For. Prod. Lab. Inf. Rep. VP-X-146, 29 p. Environ. Can. For. Dir. Vancovuer, BC

Edlin, H.L. 1968. A modern sylva or a discourse of forest trees. 25. Hemlocks, western red cedar, and incense cedar: Tsuga, Thuja, Libocedrus genera. A.J. For. 62(18):145-154.

Farmer, R.H. 1962. Corrosion of metals in association with wood. Wood 27(11):443-446.

Farr, W.A. and V.J. LaBau. 1971. Volume tables and equations for old-growth western redcedar and Alaska-cedar in southeast Alaska. USDA For. Serv. Res. Note PN@-167, 18 p. Pac. Northwest For. and Range Exp. STn., POrtland, Oreg.

Fergusson, J.A. 1938. Comparative durability of shingles and shingle naisl. Pa. Agric. Exp. Stn. Bull. 353, 25 p. Pa. State Col, Sch. Agric. and Exp. Stn. State College.

Fiest, W.C. and E.A. Mraz. 1978. Comparison of outdoor and accelerated weathering of unprotected softwoods. For. Prod. J. 28(3):38-43.

Forest Products Laboratory. 1955. Wood handbook, U.S. Dep. Agric. Agric. Handb. 72, 528 p. Washington, DC.

Forest Products Laboratory. 1966. Wood finishing: discoloration of house paints by water-soluble extractives in western redcedar and redwood. USDA For. Ser. Res. Note FPL-0132, 4 p. For. Prod. Lab., Madison, Wis.

Forest Products Laboratory, Canada. 1949. Fibreboards from mill waste. Q. Rep. For. Prod. Lab., Can. March 31, 1949:6-7

Forest Products Research Board. 1950a. Kiln seasoning. For. Prod. Res. Board, Lond. Rep. 1948:12-13 [For. Abstr. 12:3222]

Forest Products Research Board. 1950b. Wood as a causal factor in the corrosion of metals. For Prod. Res. Board, Lond. Rep. 1939-47:24-26. [For. Abstr. 12:2048]

Forestry Abstracts. 1965. Forestry the world over. For Abstr. 26:176.

Gardner, J.A.F. 1963. The chemistry and utilization of western red cedar. Can. Dep. For. Publ. 1023, 26 p. Ottawa.

Graff, J.H. and I.H. Isenberg. 1950. The characteristics of unbleached kraft pulps from western hemlock, Douglas fir, western red cedar, loblolly pine, and black spruce. II. The morphological characteristics of the pulp fibers. Tappi 33(2):94-95.

Graham, R.D. and E. Wright. 1659. Stronger spray cuts pole rot. Reprinted from Electr. World. New York, July 27, 1959. [For. Abstr. 21:1093]

Grantham, J.B., T.B. Heebink, J.M. Black, and E.A. Mraz. 1976. Natural exterior finishes for wood in the Pacific Northwest. For. Prod. J. 26(8):21-27.

Gray, V.R. and M.E. Wheeler. 1959. Waterproofing. Timber waterproofing agents. Timber Dev. Assoc. Res. Rep. C/RR/6, 10 p. London. [For. Abstr. 21:4980]

Greaves, C. and J.F. Harkom. 1949. Treatment of pencil slats. Parts 1 and 2. For. Prod. Lab. Can. Mimeogr. O-122(rev), 45 p. [For. Abstr. 12:1436] Ottawa.

Grondal, B.L. 1913. The comparative durability of Douglas-fir, western hemlock and western red cedar as determined by an investigation of the Stampede Switchback. M.S. thesis. Univ. Wash. Seattle. 39 p.

Gurnsey, F.W. 1951. Collapse in western red cedar. B.C. Lumberman 35(4):44-45, 62.

Hale, W.H. 1954. Some timbers used in pattern making. Timber Technol. 62(2178):177-179.

Hall, G.S. and T.J. Dell. 1970. Fire propagation tests on various timber species. Timber Res. Dev. Assoc. Res. Rep. WT/RR/4, 14 p. London. [For. Abstr. 33:3234]

Heining, M. and F.A. Simmonds. 1948. Length and width of unbleached sulphate pulp fibres from certain western woods. Reprinted from Pap. Ind. and Pap. World, August, 1948, 4 p. [For. Abstr. 10:2053]

Heuser, E., W. Shockley, and R. Kjellgren. 1950. The characteristics of unbleached kraft pulps from western hemlock, Douglas fir, western red cedar, loblolly pine, and black spruce. V. A study of the distribution of the degree of polymerization of the cellulose in the kraft pulps. Tappi 33(2):101-107.

Hokhold, F. 1965. Literature survey on the holding capacity of nails in western hemlock and western red cedar. Can. Dep. For. Publ. 1112, 13 p. Ottawa.

Holmes, C.A. 1971. Evaluation of fire-retardant treatments for wood shingles. USDA For. Serv. Res. Pap. FPL-158. 27 p. For. Prod. Lab., Madison.

Holzer, W.F. and K.G. Booth. 1950. The characteristics of unbleached kraft pulps from western hemlock, Douglas fir, western red cedar, loblolly pine, and black spruce. III. The comparative pulping of the woods. Tappi 33(2):95-98.

Howard, J.O. 1973. Logging residue in Washington, Oregon, and California - volume and characteristics. USDA For. Serv. Resour. Bull. PNW-44, 26 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Isenberg, I.H. 1951. Pulpwoods of United States and Canada. 2d ed. 187 p. Inst. Pap. Chem., Appleton, Wis.

Jones, K.L. 1966. Varnish-holding properties of timber. J. Oil and Colour Chem. Assoc., Slough 49(4):314-330. [For. Abstr. 28:2928]

Juneja, S.C. 1972. Stable and leach-resistant fire retardants for wood. For. Prod. J. 22(6):17-23.

Jurazs, P.E. and R.W. Wellwood. 1965. Variation in penetrability of western redcedar within a single stem section. For. Prod. J. 15(2):76-80.

Katz, A.R. and D.G. Miller. 1963. Effect of water storage on electrical resistance of wood. For. Prod. J. 31(7):255-259 [For. Abstr. 25:2737]

Keller, E.L. and J. N. McGovern. 1945. Sulfite pulping of western red cedar. USDA For. Prod. Lab. Mimeogr. R1494, 7 p. Madison, Wis.

Kirbach, E. and S. Chow. 1976. Chemical wear of tungsten carbide cutting tools by western red cedar. For. Prod. J. 26(3):44-48.

King, F.W. and F. Bender. 1951. Production of insulating fibreboard from western red cedar shingle mill waste. Pulp and Pap. Mag. Can. 52(1):75-79. [For. Abstr. 12:3190]

King, F.W. and F. Bender. 1952. Production of hard-pressed fibreboard from western red cedar mill waste. Pulp and Pap. Mag. Can. 53(6):137-141.

King, F.W. and S.C. Juneja. 1974. A new fire-retardant treatment for western redcedar shingles. For. Prod. J. 24(2):18-23.

Krueger, K.W. 1963. Compounds leached from western redcedar shingle tow found toxic to Douglas fir seedlings. USDA For. Serv. Res. Note PNW-7, 6 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Krueger, K.W. 1968. Investigations of shingle tow packing material for conifer seedlings. USDA For. Serv. Res. Pap. PNW-63, 10 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Lee, I.D.G. and A.D. Lord. 1960. Comparative test on the nailing properties of European redwood and western red cedar. Timber Dev. Assoc., Lond., Test Mem. E/TM/40, 17 p. [For. Abstr. 22:3596]

Ladell, J.L. 1953. High-temperature kiln drying of Canadian woods: report of exploratory investigations - softwoods. For. Prod. Lab. Can. Mineogr. 0-170, 11 p. Ottawa. [For. Abstr. 14:3912]

Lewis, H.F., L.E. Wise, and B.L. Browning. 1950. The characteristics of unbleached kraft pulps from western hemlock, Douglas fir, western red cedar, loblolly pine, and black spruce. I The chemical constituents of the unbleached kraft pulps. Tappi 33(2):92-94.

Loughnane, J.B. and L. U. Gallagher. 1963. A note on damage caused to apples by storage in Thuja plicata boxes. Ir. For. 20(1):17-18. [For. Absdtr. 25:136]

Lumberman, 1957. Cedar shakes stage big comeback. Lumberman 84(10):40-45.

Lutz, J.F. 1972. Veneer species that grow in the United States. USDA For. Serv. Res. Pap. FPL-167, 127 p. For. Prod. Lab., Madison, Wis.

Lyon, E.D. 1939. Machine shave, sterilize, sapwood to stop cedar pole sap rot. Electr. World, New York 112:455-456, 515. [For Abstr. 2:63]

MacBride, C.F. 1959. Utilizing residues from western red cedar mills. For. Prod. J. 9(9):313-316.

MacDonald, B.F. and H. MacLean. 1965. High temperature drying doesn't weaken western red cedar shingles. Can. For. Ind. 85(3):93, 95.

MacLean, H. 1970. Influences of basic chemical research on western red cedar utilization. For. Prod. J. 20(2):48-51.

MacLean, H. and J.A.F. Gardner. 1953a. Heartwood extractives in digester corrosion. Pulp and Paper Mag. Can. 54(12):125-130.

MacLean, H. and J.A.F. Gardenr. 1953b. Some chemical and plastic properties of western red cedar butt rot. J. For. Prod. Res. Soc. 3(4):35-37, 72.

Maloney, T.M. 1973. Bark boards from four west coast softwood species. For. Prod. J. 23(8):30-38.

McGowan, W.M. and W.J. Smith. 1965. Strength and related properties of western red cedar poles. Can. Dep. For. Publ. 1108, 34 p. Ottawa. [For. Abstr. 27:2912]

McGovern,J.N., J.S. Martin, and R.M. Kingsbury. 1951. Semichemical pulping characteristics of Pacific coast red alder, Douglas fir, western redcedar, and western hemlock. USDA For. Prod. Lab. Rep. R1912, 10 p. For. Prod. Lab. Madison, Wis. [For. Abstr. 14:1707]

Meyer, R.W. and G.M. Batron. 1971. A relationship between collapse and extractives in western red cedar. For. Prod. J. 21(4):58-60 [For. Abstr. 32:7098]

Ministry of Agriculture, Belfast. [n.d.] Wastage of apples in relation to the type of wood used in the construction of storage boxes. Res. and Exp. Rec. Minist. Agric. Belfast 10(2):269-270. [For. Abstr. 24:2837]

Mitson, B.E. and B.D. Holman. 1975. Red cedar shingles and shakes: unique wood industry. Oral history interviews with Elwood R. Maunder. J.For. Hist. 19(2):56-71.

Moore, W.C. and J. Bryan. 1946. Preserving boxes used in horticulture. J.R. Hortic. Soc. 71(3):79-84.

Munger, D.A. 1970. A survey of the western red cedar shake industry of the Pacific Northwest. M.S. thesis. 65 p. Univ. Wash., Seattle.

Murray, C.E. and B.B. Thomas. 1961. Papermaking characteristics of cedar fiber. Tappi 44(9):625-633.

Newton, W. 1953. Seed germination and seedling growth as influenced by different kinds of sawdust. Can. J. Agric. Sci. 33(6):593-596. [For. Abstr. 15:2945]

O'Hea, I.J. 1947. Performance of red cedar shingles in U.K., B.C. Lumberman, June 1947:95-100.

Packee, E.C. 1976. An ecological approach toward yield optimization through species allocation. Ph.D. thesis. Univ. Minn. St. Paul. 740 p.

Palka, L.C. and W.G. Warren. 1977. Grouping of Canadian veneer species based on plywood rolling-shear properties. West. For. Prod. Lab., Can. Inf. Rep. VP-X--163, 38 p. Vancouver, BC.

Panshin, A.J. and C. deZeeuw. 1970. Textbook of wood technology. 3d ed. 705 p. McGraw Hill Book Co., New York.

Priest, D.T. 1974. Sawmilling properties of four minor home grown softwoods. For. and Home Grown Timber 3(5):33-36. [For. Abstr. 36:2315]

Proctor, A.R. and W.M. Chow. 1976. Simulated hardwood market kraft pulp from western red cedar sawdust. Tappi 59(2):119-123.

Purslow, D.F. 1962. The effect of specimen size on the life of timber in contact with the ground. Wood 27(3):99-100. [For. Abstr. 23:5875]

Railway Track and Structures. 1955. New lease of life for untreated timber piling in service. Railroad Track and Struct. Chicago 51(9):48-49.

Randall, R.M. and C.F. Sutherland, Jr. 1974. Marketing Oregon-produced poles and piling. Oreg. State Univ. For. Res. Lab. Res. Pap. 24, 11 p. Corvallis.

Research News, Ottawa. 1962a. Density and hardness information. Summarized in For. Abstr. 23:161.

Research News, Ottawa. 1962b. Metal corrosion information. Summarized in For. Absdtr. 23:720.

Roff, J.W. 1964. Service life of western red cedar in water cooling towers in Canada. Can. Dep. For. Publ. 1078, 6 p. Ottawa. [For. Abstr. 26:2953]

Ruderman, F.K. 1978. Production, prices, employment, and trade in Northwest forest industries, second quarter 1978. USDA For. Serv. Pac. Northwest For. and Range Exp. Stn., 68 p. Portland, Oreg.

St. Clair, W.E. 1969. Leach resistant fire-retardant treated wood for outdoor exposure. Am. Wood Preserv. Assoc. Proc. 65:250-259.

Salamon, M. 1960. Kiln drying of unbundled shingles at high temperatures. Timber Can. 21(9):35-37 [For. Abstr. 22:2505]

Salamon, M. and J. Hejjas. 1971. Faster kiln schedules for western red cedar and their effect on quality and strength. Inf. Rep. VP-X-74, 20 p. For. Prod. Lab., Vancouver, BC [For. Abstr. 33:3443.]

Sargent, C.S. 1933. Manual of the trees of North America (exclusive of Mexico). 910 p. Houghton Mifflin Co., Boston and New York.

Scheffer, T.C. and R.D. Graham. 1973. Bioassay estimation of sapwood protection in spray-treated western redcedar poles. For. Prod. J. 23(9):106-109.

Schwartz, H. 1949. Structural boards from cedar barks. Paper Trade J. 128(24):27-28.

Scroggins, T.L. and R. Currier. 1971. Agricultural uses for western redcedar residues from shake and shingle mills. For. Prod. J. 21(11):17-24.

Sharpe, G.W. 1974. Western redcedar. 144 p. Univ. Wash. Print. Co., Seattle.

Skolmen, R.G. 1968. Natural durability of some woods used in Hawaii - preliminary findings. USDA For. Serv. Res. Note PSW-167, 7 p. Pac. Southwest For. and Range Exp. Stn., Berkeley.

Smith, J.H.G. 1964b. Root spread can be estimated from corwn width of Douglas fir, lodgepole pine and other British Columbia tree species. For. Chron. 40(4):456-473.

Southern Lumberman. 1961. Super-highways built of sawdust? It's happening today. South. Lumberman. 1961 (Jan 1):28.

Sowder, A.M. 1927. A preliminary study of the toxicity of water soluble extractives and the relative durability of water treated woodflour of western red cedar (Thuja plicata). M.S. thesis. Univ. Idaho, Moscow, 26 p.

Stewart, D.L. and D.L. Butler. 1968. Hardboard from cedar bark. For. Prod. J. 18(12):19-23.

Swan, E.P[. and K.S. Jiang. 1970. Formation of heartwood extractives in western red cedar. Tappi 53(5):844-846.

Swan, E.P., K.C. Jiang, and J.A.F. Gardner. 1969. The lignans of Thuja plicata and the sapwood-heartwood transformation. Phytochemistry 8(2):345-351. [For Abstr. 31:1362]

Syrach Larsen, C. 1943. Erfaringer med udenlandske Traearter i dansk Skovsbrug. Sven. Skogsvardsforb, Stockholm, Tidskr. 41:166-199.

Thomas, P.R. and R.E. Davis. 1974. Whole log chipping and pulping of western red cedar at Columbia Cellulose. Pulp and Pap. Mag. Can. 75(3):60-63. [For. Abstr. 35:6531]

Tickle, C. 1963. Decay is rare in western red cedar. Wood 28(5):199-210.

Tiemann, H.D. 1941. Collapse in wood as shown by the microscope. J. For. 39(3):271-282.

Titmuss, F.H. 1965. Commercial timbers of the world. 3d ed. 277 p. Tech. Press Ltd., London.

Troxell, H.E. 1954. The use of Rocky Mountain species for pulping. J. For. 52(8):583-586

Trust, T.J. and R.W. Coombs. 1973. Antibacterial activity of - thujaplicin. Can. J. Microbiol. 19(11):1341-1346.

Vastokas, J.M. 1969. Architecture and environment: The importance of the forest to the Northwest coast Indian. For. Hist. 13(3):12-21.

Veer, J.J.G. and F.W. King. 1963. Moisture blistering of paints on house siding. Can. Dep. For. Publ. 1024, 25 p. Ottawa.

Viereck, L.A. and E.L. Little, Jr. 1972. Alaska trees and shrubs. U.S. Dep. Agric. Agric. Handb. 410, 265 p. Washington, DC

West Coast Lumber Trade Extension Bureau. 1927. Western red cedar "the enduring wood of the ages." 24 p. Portland, Oreg.

West Coast Lumberman. 1941. Chemical treatment prevents checking of cedar poles. West Coast Lumberman 68(9):48.

West Coast Lumberman. 1946. A new plywood product. Western red cedar panels. West Coast Lumberman 73(5):66.

Western Australia Forests Department. 1961. Cooling tower tests. For. Dep. West. Aust. Rep. 1960/61"14. [For. Abstr. 23:4362]

Wethern, J.D. 1959. Pulp and chemical potential for western red cedar utilization. For. Prod. J. 9(9):308-313.

Wilson, J.W., H. Worster, and D. O'Meara. 1960. The sulphate pulping of some south central British Columbia wood species. Pulp and Pap. Mag. Can. 61(1):19-24.

Wood. 1959. Canadian building timbers. Wood 24(8):322-325.

Woodhead, W.D. 1969. Natural finishes on wood. For. Prod. Newsl. Commonw. Sci. and Ind. Res. Org., Melbourne, Aust. 365:2-4. [For. Abstr. 31:3436]

APPENDIX 7 - SELECTED FORESTRY, FOREST PRODUCTS, MARKETING AND BUSINESS ASSOCIATIONS - US AND CANADA

American Assoc. of Nurserymen
230 Southern Bldg.
Washington, DC 20005
(202) 737-4060

American Board Products Assoc.
205 W. Touhy Ave.
Park Ridge, IL 60068
(312) 692-5178

American Plywood Assoc.
7011 South 19th
P.O. Box 11700
Tacoma, WA 98411
(206) 565-6600

Casket Manufacturers Assoc. of America
708 Church Street
Evanston, IL 60201
(312) 866-8383

Fibre Box Assoc.
224 South Michigan Avenue
Chicago, IL 60604
(312) 663-0257

Furniture Manufacturers Assoc. of Grand Rapids
220 Lyon St., N.W.
Grand Rapids, MI 49503
(616) 456-9691

Inland Cedar Association
2702 N.W. Blvd.
Spokane, WA 99205

Material Handling Institute, Inc.
1326 Freeport Rd.
Pittsburgh, PA 15238
(412) 782-1624

National Assoc. of Furniture Manufacturers
8401 Connecticut Ave., Suite 911
Washington, DC 20015
(301) 657-4442

National Bark Producers Assoc.
1750 Old Meadow Road
McLean, VA 22101
(703) 790-9776

National Kitchen Cabinet Assoc.
136 St. Matthews Avenue
Louisville, KY 40207
(502) 896-2231

National Paint and Coatings Assoc.
1500 Rhode Island Avenue, N.W.
Washington, DC 20005
(202) 462-6272

National Particleboard Assoc.
2306 Perkins Place
Silver Spring, MD 20910
(301) 587-2204

National Wholesale Furniture Assoc.
111 E. Wacker Dr.
Chicago, IL 60601
(312) 644-6610

National Wooden Pallet and Container Assoc.
1619 Massachusetts Ave., N.W.
Washington, DC 20036
(202) 667-3670

North American Wholesale Lumber Assoc.
1144 Clifton Ave.
P.O. Box 713
Clifton, NJ 07013
(201) 473-0182

Red Cedar Shingle & Handsplit Shake Bureau
515-116th Avenue, N.E. Suite 275
Bellevue, WA 98004
(206) 453-1323

Western Red Cedar Lumber Assoc.
Yeon Bldg.
Portland, OR 97204
(503) 224-3930

Western Red and Northern White Cedar Assoc.
P.O. Box 2786
New Brighton, MN 55112
(612) 925-3463

Western Wood Moulding & Millwork Producers, Inc.
P.O. Box 25278
Portland, OR 97225
(503) 292-9288

Western Wood Products Assoc.
1500 Yeon Building
Portland, OR 97204
(503) 224-3930

Western Wooden Box Assoc.
430 Sherman Avenue, Suite 106
Palo Alto, CA 94306
(415) 327-8200

Wirebound Box Manufacturers Assoc., Inc.
1211 W. 22 St.
Oak Brook, IL 60521
(312) 654-3020

Wood Energy Institute
P.O. Box 1
Fiddlers Green
Waitsfield, VT 05673
(802) 496-2508

Wood Moulding & Millwork Producers
P.O. Box 25278
1730 S.W. Skyline Blvd.
Portland, OR 97225
(503) 292-9288

Canadian Kitchen Cabinet Assoc
27 Goulburn Avenue
Ottawa, Ontario
K1N 8C7
(613) 233-6205

Canadian Particleboard Assoc.
27 Goulburn Ave.
Ottawa, Ontario
K1N 8C7
(613) 233-6205

Canadian Waferboard Assoc.
701-170 Laurier Avenue W.
Ottawa, Ontario
K1P 5V5
(613) 235-7221

Canadian Window and Door Mfrs. Assoc.
27 Goulburn Ave.
Ottawa, Ontario
K1V 6V3
(613) 233-6205

Lumber & Building Materials Assoc.
4500 Sheppard Ave. E. Unite "F"
Agincourt, Ontario
M1S 3R6
(416) 298-1731

Wholesale Lumber Dealers Assoc.
2259 Bloor St. W
Toronto, Ontario
M6S 1N8
(416) 769-8267